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In addition our management has elected to perform the study if awarded to FSDS for a fixed fee of seven (7) percent.

All the items required by your requested "Proposal Format" (Items I thru VII) have been included in enclosure (1) technical proposal. Item VIII has been included as enclosure (2). To eliminate the confussion of tracing your proposal format requirements to the proposal, the following listing is the proposal sections enclosure (1) as they relate to your proposal format requirements.

Customer Proposal Format		Enclosure (1) Proposal Section or Page
I.	Task Abstract	Page I
II.	Introduction	Section I. 0
III.	Technical Discussion	Section 2. 0
IV.	Work Statement	Section I. 4
V.	Deliverable Items	Section 3. 3
VI.	Schedule by Porcentages	Section 3. 0 table 3. 1
VII.	Time Bar Chart	Section 3. 0 figure 3. 2

This quotation is considered firm for a period of ninety (90) days.

If any questions should arise concerning the above matter please do not hesitate to contact the undersigned.

Very truly yours,

STAT

Contract Administrator

RRB/kw
Enc. Eight (8)

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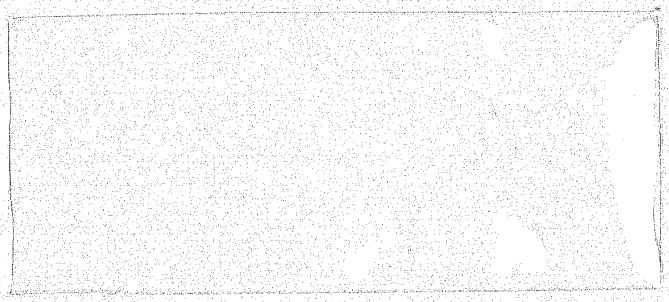

FAIRCHILD

SPACE AND DEFENSE SYSTEMS

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FAIRCHILD SPACE AND DEFENSE SYSTEMS
A Division of Fairchild Camera and Instrument Corporation
300 Robbins Lane, Syosset, New York

Proposal No. ED-CG-83
16 January 1970

AUTOMATED FILM TRANSPORT STUDY

(S.I. 200,067)

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ABSTRACT

Fairchild proposes to conduct an engineering study which will provide an investigation, analysis and preliminary designs of state-of-the-art automatic film loading, self threading, film transport and related dynamic/static film support technologies. This study will evaluate the film transport characteristics of existing state-of-the-art equipments, define automated film transport design requirements and, where applicable, demonstrate concepts by breadboard evaluations. All related technical efforts and achievements will be documented in the final report. The resultant output will provide the Government with an automated film transport technology base for new imagery exploitation equipments.

The following are the estimated cost details for the proposed study:

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SECTION 1

INTRODUCTION

1.1 GENERAL

This proposal is prepared by Fairchild Space and Defense Systems, a Division of Fairchild Camera and Instrument Corporation, in response to the Development Objectives document, dated 26 November 1969 entitled "Automated Film Transport Study". These objectives describe the concept and requirements for a study of automatic film loading, threading and transporting techniques as related to imagery exploitation equipment.

1.2 FSDS INTEREST

FSDS's extensive background and experience in the many disciplines of imagery acquisition and exploitation equipments makes it well qualified to perform the required study, analysis and applied research of automated film transport systems. Of particular interest in the proposed program is FSDS's extensive capabilities in designing and developing a wide range of image exploitation equipments such as direct viewers, rear projection viewers, multisensor viewers, viewer/printers, enlarging printers, film titlers and photo processors. Each of these equipments contain roll film transports which utilize either manual and/or motorized techniques as the basic means for transporting the film across their respective viewing, processing or printing surfaces. Figure 1-1 shows various film threading configurations and summarizes the pertinent film transport characteristics of some representative FSDS - developed imagery acquisition/exploitation equipments. In addition to the image exploitation equipments, FSDS has over 50 years experience in the design and fabrication of complex film transport systems for a variety of airborne cameras.

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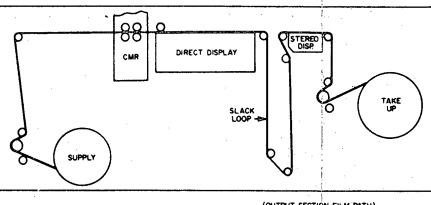
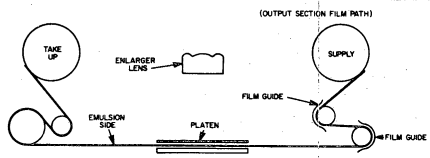
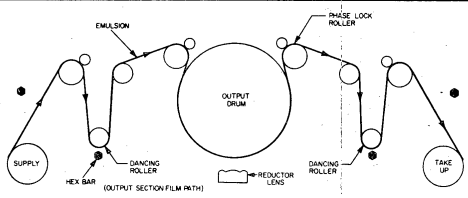
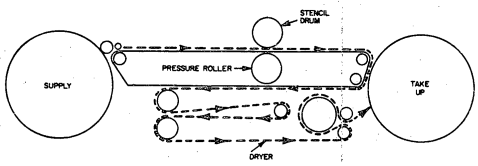
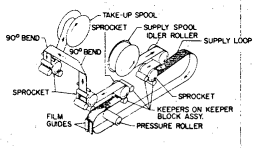
IMAGE EXPLOITATION/ ACQUISITION EQUIPMENT	FILM TRANSPORT THREADING DIAGRAM	FILM TRANSPORT CHARACTERISTICS
MULTISENSOR VIEWER TIPI IMAGE INTERPRETATION STATION		CONSISTS OF TWO INDEPENDENT FILM TRACKS CAPABLE OF HANDLING FILM WIDTHS OF 70MM, 5", 6 1/2" AND 9 1/2". FILM BASE THICKNESSES RANGE FROM .0025" TO .010" AND DIFFUSION TRANSFER MATERIAL TO .012". MOTORIZED OR MANUAL DRIVE, AUTOMATIC OR MANUAL CONTROL, EACH CHANNEL INDEPENDENTLY. FILM SPEEDS FROM .5 TO 40 INCHES/SEC., FORWARD AND REVERSE. SLACK LOOP ENABLES STEREO VIEWING OF FRAMES UP TO 105 INCHES. GLASS PLATEN HOLD DOWN.
ENLARGING PRINTER PHOTOGRAMMETRIC ENLARGER		MOTORIZED FILM DRIVE. GLASS PLATEN HOLD DOWNS. FILM CAPACITY INPUT: -5 INCH ROLLS UP TO 500 FEET, 70MM ROLLS UP TO 500 FEET. FILM CAPACITY OUTPUT 9 INCHES UP TO 500 FEET. PROVIDES 2X AND 4X ENLARGEMENTS.
REDUCTION PRINTER PHOTOGRAMMETRIC REDUCTOR		MOTORIZED FILM DRIVE. FILM CAPACITY INPUT: -9 INCH ON 7.7 DIAMETER SPOOL. OUTPUT: 5 INCH ON 7.7 DIAMETER SPOOL. THE UNEXPOSED FILM IS TRANSPORTED AROUND AN ALUMINUM DRUM AND ONTO THE TAKEUP REEL. PROVIDES REDUCTIONS OF 2X, 4X AND 9X.
FILM TITLER/LIGHT TABLE BS-12 FILM TITLER		CONSISTS OF ONE MOTORIZED CHANNEL CAPABLE OF HANDLING FILM WIDTHS RANGING FROM 70MM TO 9 1/2 INCHES UP TO 1000 FEET LENGTHS. FILM TRANSPORT SPEED VARIES FROM 0 TO 70FPM (PRESENT DESIGN GOAL IS TO ATTAIN 150FPM), FORWARD AND REVERSE.
PANORAMIC CAMERA F-415Y PANORAMIC CAMERA		THE SUPPLY SPOOL STORES UP TO 1800 FEET OF FILM AND MOUNTS ON TWO KEYED SHAFTS. THE CAMERA OPERATES FROM 0.63 TO 3.1 FRAMES PER SECOND. EACH FRAME FORMAT IS 2.25 INCHES X 10.25 INCHES. FILM PATH ALLOWS COMPACTNESS BY PROVIDING 90° BENDS OF FILM.

FIGURE 1-1. FILM TRANSPORT PARAMETERS OF REPRESENTATIVE FSDS EQUIPMENTS

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An example of a typical equipment is the Imagery Interpretation Station recently designed and developed by FSDS for the Tactical Information Processing and Interpretation (TIPI) System. This multisensor viewing instrument, consisting of a light table, stereo viewing table, roll film rear projection viewer and map chip projector, contains an individually controlled two-channel motorized film transport system capable of either operator or automatic control, depending upon the required mode of operation. In addition to TIPI, FSDS has designed and developed film transport systems for a variety of panoramic and frame cameras as well as for numerous image exploitation equipments such as Multisensor Viewer (Image Interpretation Central), Photogrammetric Enlarger and Reductor, BS-12 Film Titler, Multipurpose Data Block Reader, F-511, 512 and 576 Viewer/Printers and the Reproducer/Processor for the U.S. Army Photo Transmission System.

In brief, FSDS has long term interest and experience in the technology associated with automated film transport systems, particularly as they relate to imagery acquisition and exploitation equipments. The capabilities evolved from this long term interest have provided a comprehensive body of experience which relates directly to the type of study required. Therefore, because of particular interest and well developed capabilities, Fairchild Space and Defense System submits this technical discussion in response to the request from the Government.

1.3 STUDY OBJECTIVES

The objective of this study is to investigate state-of-the-art techniques of automated film transport systems. This will include an investigation of automatic film loading and self-threading techniques, including the evaluation of dynamic film support technology. As a result of this investigation, it will be possible to determine those techniques which are best suited for film viewing (light tables and rear projection viewers) and printing (contact and enlarging printers) equipments. This will provide the Government with a greater technology base upon which it can readily utilize, particularly when designing and evaluating new film viewing and printing equipments containing roll film transports.

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The investigation will identify feasible solutions for the set of problems relating to the automation of film transport systems. FSDS is aware that there is usually more than one feasible solution to any design problem. Consequently it will be necessary to establish specific design goals related to automated film transport system performance and technology prior to the start of the study. These film transport design goals should include as a minimum, the achievement of the following performance criteria:

a) Reduction in film loading and threading time.

b) Transport of single and double strands of varying film widths.

c) Provide wide range of film transport speeds under smooth and positive control.

d) Prevention of film damage.

e) Compact configuration.

f) Maintain flat film image during transport.

To achieve the desired optimized design, the following major investigations/objectives will be used as a work plan relative to the Automated Film Transport Study:

- Evaluate existing state-of-the-art equipments.

- Define automated film transport system requirements.

- Perform breadboard feasibility evaluations.

- Prepare final report.

Figure 1-2 shows the activity flow relationships between the four basic phases of the proposed study.

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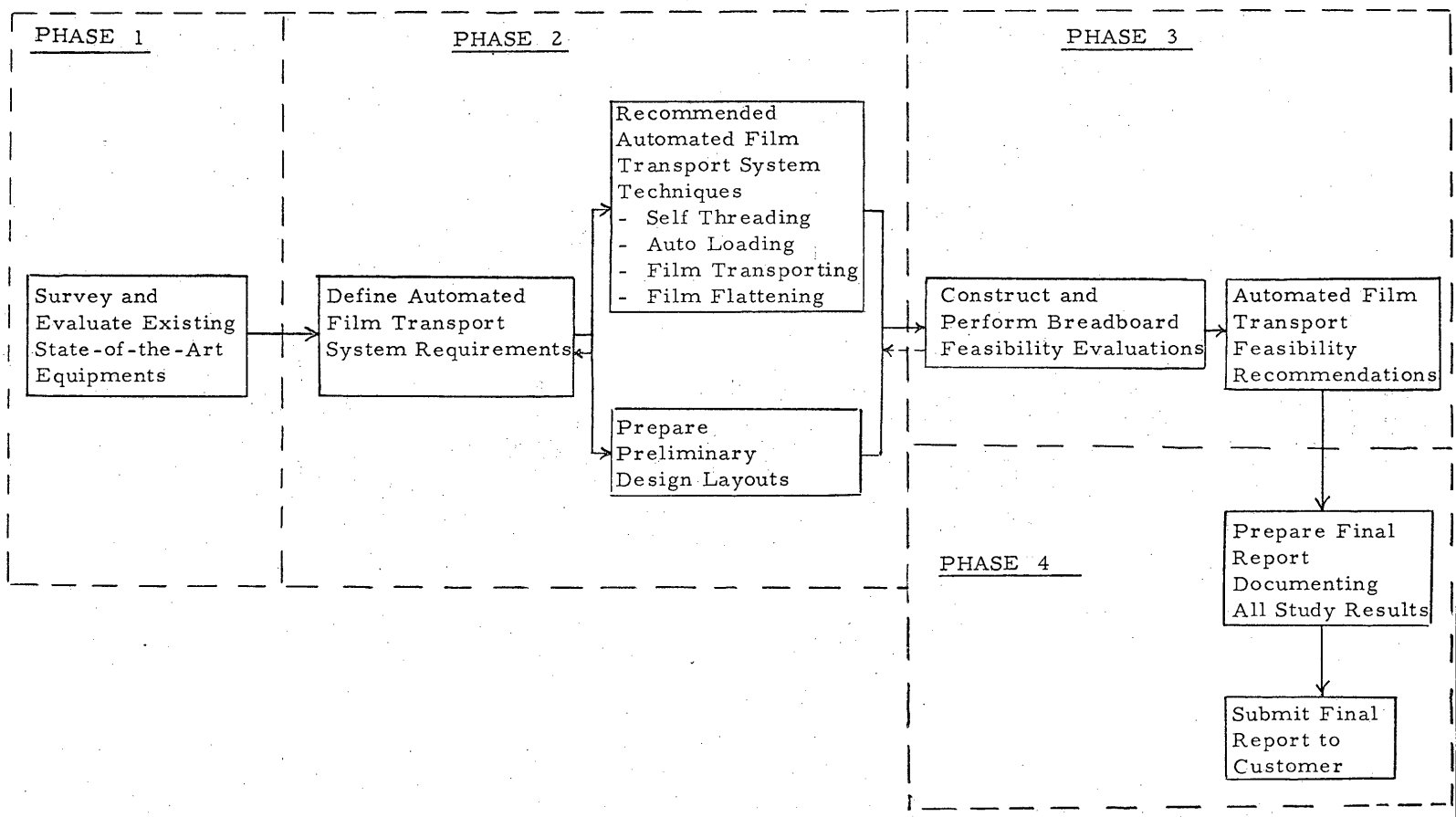
PHASE 1
PHASE 2
PHASE 3
PHASE 4
Survey and Evaluate Existing State-of-the-Art Equipments
Define Automated Film Transport System Requirements
Recommended Automated Film Transport System Techniques
- Self Threading
- Auto Loading
- Film Transporting
- Film Flattening
Prepare Preliminary Design Layouts
Construct and Perform Breadboard Feasibility Evaluations
Automated Film Transport Feasibility Recommendations
Prepare Final Report Documenting All Study Results
Submit Final Report to Customer

FIGURE 1-2 PROGRAM ACTIVITY FLOW DIAGRAM

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1.4 IMPLEMENTATION PLAN (WORK STATEMENT)

The Implementation Plan (Work Statement) for the Automated Film Transport Study is presented in Table 1-1. The plan identifies in an orderly progression, a series of phases whose major objectives and tasks will lead to the fastest, most economical and efficient acievement of the desired results. Although Table 1-1 is not a schedule, it indicates the task sequence to be undertaken. This Implementation Plan can be considered to be an outline of the proposed program and the basis for scheduling and estimating the tasks and activities discussed in Section 2.

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TABLE 1-1

PROGRAM IMPLEMENTATION PLAN (WORK STATEMENT)

AUTOMATED FILM TRANSPORT STUDY

OBJECTIVE	TASK	RESULTS
Phase 1: Evaluate Existing State-of-the-Art Equipments	1.1 Survey state-of-the-art equipments utilizing technologies applicable to automated roll film transport systems such as: a) Rear projection viewers b) Light tables c) Contact printers d) Enlarging printers e) Film processors f) Film editing consoles g) Film titlers h) Aerial cameras i) Motion picture cameras j) Motion picture projectors k) Microfilm readers l) Magnetic tape systems m) Paper handling mechanisms 1.2 Visit user agency 1.3 Define existing film transport system performance characteristics considering a) Film accommodation capabilities (film width, thickness, film material and roll length) b) Film loading and threading capabilities	1. Analysis of the advantages, disadvantages and limitations of existing roll film transport systems. 2. Preliminary determination of degree of repackaging and/or modification required to implement desired automated roll film transport techniques. 3. Determination of potential new automated film transport designs and/or avenues of investigation. 4. Categorization and tabulation of pertinent performance characteristics of existing state-of-the-art film transport systems, including comparison matrix.

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TABLE 1-1

PROGRAM IMPLEMENTATION PLAN (WORK STATEMENT)

(CONTINUED)

OBJECTIVE	TASK	RESULTS
Phase 1: Evaluate Existing State-of-the-Art Equipments	c) Film flattening mechanisms and techniques (dynamic and static) d) Film registration, tracking and tension capabilities e) Film transport speed ranges for scanning and slewing f) Computer interface g) Reliability and maintainability h) Noise and vibration i) Safety hazards j) Special operating requirements k) Size, weight and configuration l) Environmental operating requirements m) Cost 1.4 Determine capability for modifying and adapting applicable film transport system techniques to various film viewing and printing equipments. 1.5 Determine functions not completely satisfied by existing film transports by review of pertinent equipment design characteristics.	

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TABLE 1-1

PROGRAM IMPLEMENTATION PLAN (WORK STATEMENT)

(CONTINUED)

OBJECTIVE	TASK	RESULTS
Phase 2: Define Automated Film Transport System Requirements	2.1 Detailed investigation of the pertinent design characteristics of the various applicable automated film transport techniques, with particular emphasis placed upon achieving the following performance goals: a) Reduction in loading and threading time b) Capability for handling wide range of film format sizes and base materials c) Provide wide range of film transport speeds under smooth and positive control d) Maintain flat film image during dynamic and static modes considering: (1) Edge guides (2) Air suspension (3) Fluid suspension (4) Electrostatic suspension (5) Platen hold down (6) Vacuum holddown (7) Positive air pressure (8) Tension rollers (9) Film tension	5. Derivation of most applicable solutions for the Automated Film Transport technology base. 6. Applicability and adaptability of film transport techniques to various equipment configurations 7. Preliminary design layouts of recommended film transport techniques. 8. Recommendation as to the breadboarding and evaluation of specific film transport concepts (refer to Phase 3).

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TABLE 1-1

PROGRAM IMPLEMENTATION PLAN (WORK STATEMENT)

(CONTINUED)

OBJECTIVE	TASK	RESULTS
Phase 2: Define Automated Film Transport System Requirements	e) Provide both film and operator safety. f) Optimum mechanical design (1) Structual (2) Accoustical (3) Reliability and maintainability (4) Compact configuration g) Environmental compatibility h) Human factors compatibility 2.2 Determine which film transporting techniques can be applied to film viewing equipments and which to printing equipments. 2.3 Define critical interface requirements 2.4 Determine commonality of various film transport design approaches 2.5 Initiate preliminary design efforts of recommended film transport techniques. 2.6 Determine time required to breadboard individual film transport techniques.	

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TABLE 1-1

PROGRAM IMPLEMENTATION PLAN (WORK STATEMENT)

(CONTINUED)

OBJECTIVE	TASK	RESULTS
Phase 3: Perform Breadboard Feasibility Evaluations.	3.1 Construct breadboard model, where applicable, to demonstrate technical feasibility of recommended automatic loading, threading film drive and control and dynamic/static film support techniques. Demonstrate results to customer. 3.2 Evaluate interface adaptability with existing GFE film viewing and printing equipments, if available. 3.3 Determination of functional capabilities based upon interface adaptability. 3.4 Determine man-machine interface factors. 3.5 Develop estimated time and cost parameters necessary to incorporate proven automated film transport techniques into various existing film viewing/printing equipments and possible new system configuration.	9. Recommendations as to best solutions for automated film transport techniques and adaptability to various film viewing and printing equipments. 10. Recommendations for design program for defining automated film transport configurations, performance criteria, estimated time and cost factors, future considerations.

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TABLE 1-1

PROGRAM IMPLEMENTATION PLAN (WORK STATEMENT)

(CONTINUED)

OBJECTIVE	TASK	RESULTS
Phase 4: Prepare Final Report	4.1 Organize all previous study findings (reports, tabulations, analyses, design layouts, etc.) relating to Phases 1-3. 4.2 Develop specific conclusions and recommendations. 4.3 Publish comprehensive final report of commercial quality. 4.4 Submit final report to customer.	11. Final Report outling all technical efforts and achievements, including conclusions and recommendations.

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SECTION 2

FILM TRANSPORT STUDY CONSIDERATIONS

2.1 GENERAL

This section describes the considerations and analysis tasks that will be performed during the Automated Film Transport study. The effort will involve:

a) equipment survey - investigation of equipments utilizing technologies and techniques applicable to roll film transport systems.

b) data evaluation - analysis, selection and categorization of applicable techniques to the various equipments.

c) applied research - breadboarding of existing technology for applicability to study goals.

d) analysis and recommendations - comprehensive documentation of study.

2.2 EQUIPMENT SURVEY

2.2.1 Data Collection

The data collection phase of the study will consist of literature and equipment surveys. It will include a complete analysis of the advantages, disadvantages and limitations of the various transport mechanisms investigated.

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The investigation will encompass not only the film transport mechanisms for Image Interpretation equipments, cameras and printer-processors, but will also examine the transport systems of tape drives and other roll feed mechanisms. For example, a vast reservoir of techniques for handling roll materials has been accumulated by the paper handling and newspaper industry. It is quite feasible that these techniques can be implemented towards improving roll film transport designs.

Of particular benefit to this proposed study is the data accumulated for film transports criteria established by FSDS under the Modular I.I. Study for the Navy [redacted] In addition Fairchild's vast background and knowledge of related equipments is available for the proposed study. STAT

2.2.2 Film Transport Characteristics

The study will define the film transport design characteristics required for the various equipments. For example, it can be readily understood that the film transport design characteristics for a simple light table would differ from the design required for a contact printer. Therefore, the design requirements for each equipment must be independently evaluated and the parameters categorized. Some of these parameters include:

Function Suitability	-	Does the transport system perform as required? What are the limitations?
Maintainability	-	Ease of repair, access to components.
Reliability	-	How reliable is the drive system, should reliability differ for various drive requirements?

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Cost	-	What are the estimated costs between the various drive designs? The costs must be related to the various design features.
Modification Capability	-	Is the design unique for a particular operation? Can it be incorporated into other equipments?
Special Operating Techniques	-	Are special operating techniques required that are too demanding of the operator?
Safety Hazards	-	Is the design detrimental to man or materials?
Adaptive Facilities for Increased Capacity	-	Ability to be modified for increased functional capacity - such as larger film spools, higher speeds, etc.
Environmental Requirements	-	Are special operational environments required?

After the film transport design and/or techniques have been reviewed a tabulation will be made so as to group the designs into two categories. One group will address itself to techniques applicable to film viewing, the other to film printing. The various design approaches will be weighted based upon trade-off factors. The resulting tabulation will indicate the most suitable designs for the particular type of equipment.

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2.2.3 Vendor Considerations

Vendor inputs will be solicited as deemed desirable during the study. These solicitations will be directed not only towards data acquisition but will encompass discussions related to costs and design impacts necessitated by the incorporation of additional features to their equipments. (For example, the addition of a self-threading feature to a printer-processor). Vendor inputs are, therefore, considered valuable and can greatly aid in providing proper emphasis to portions of the study.

In addition, the extensive files of Recon Central will be solicited for additional data collection inputs related to film transports.

2.3 DESIGN CONSIDERATIONS

There are numerous motorized film transport and control systems available with varying degrees of complexity. In addition there are many transports for roll materials which in many respects duplicate roll film transport design parameters. The designs for these systems normally entail motors and controls, material handling means, and working station where some function is performed on the roll material such as printing, image interpretation etc. The study, therefore, will examine the design features of the many transport systems in order to derive the most applicable solutions for the Automated Film Transport technology base.

Typical of the equipments that will be examined are:

Viewers -

NRI Variscan, Mark II
Richardson Model 706F
Nortronics Model 707R
Houston Fearless MPS-3
B&L Sloping Screen Viewer
IBM Micro Viewer Model 9949

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Light Tables -

Richards Model GFL 940 Series
ITEK Dual Path Viewer
HRB Singer Model 787-TTT
Houston Fearless Model 1155QC
FSDS Model F513
Photogrammetry Model 1155C

Contact Printers -

Miller-Holzworth Type EN-6A
Log Etronics Type EN-39
Kodak Type EN-90A
Houston Fearless Model CP6-35
ITEK Contact Printer

Enlarging Printers -

Weeco Model 41-P
Kodak Enlarger 10-20-40X
ITEK Enlarger, Photographic, Panoramic
FSDS Enlarger, Precision

Commercial Equipment -

Paper Handling Transport Mechanisms
Microfilm Readers
Magnetic Tape Transports

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2.3.1 Film Management

2.3.1.1 Film Sizes

Film transport systems must be capable of handling various types of film bases (ex-polyester, acetate, mylar, etc.) in thicknesses ranging from .0015 inches to .012 inches, widths from 70 mm to 9-1/2 inches and roll sizes to 1000 feet. A transport system capable of handling the above parameters will accommodate most films now in use with some latitude for future expansion. The study will direct itself to examining the film size handling parameters of existing equipments and make recommendations for increasing the potential of the most meritous designs.

Design study will be given to existing techniques that can be utilized for a universal spool that can accommodate various width film.

2.3.1.2 Film Handling

Film transports must facilitate easy loading, unloading and threading of film for either single or multiple spools. The operational requirements between light tables, viewers and printer processors are similar. Operational differences encompass:

- ambient loading conditions - such as ambient available light, hand access space, visibility
- types of drive spindles
- methods for locking spool on drive
- physical operations involved in loading-unloading process

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The various design approaches will be examined and reviewed in order that the most efficient design or combination of design features will be combined into the most efficient method for loading and unloading film in each equipment category.

Differences in design approaches also occur where automatic loading and threading is concerned. For example, the threading path of the film on a light table concerns itself with being traversed over a lighted surface as compared to the more complex path required by film going through a printer. The study must, therefore, address itself not only to the differences in requirements between the various equipments but also to related complexities and feasiblity for achieving automatic loading and self-threading on complex equipment.

2.3.1.3 Transport Drives

Transport drives should exhibit smooth acceleration and deceleration without undue noise and vibrations. Basically the transport drives for the equipments have the same requirements, -

- smooth acceleration
- smooth deceleration
- positive control
- slew, scan and creep capability

Design parameters for the above requirements must be examined in great detail. For example, acceleration-deceleration characteristics are important from a film damage point of view. Maximum permissible acceleration values are dependent on film base, width and thickness that will be utilized in a particular device. Consequently the design considerations must define acceptable acceleration-deceleration stress levels for each task that the drive must perform.

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The controls of the transport drives are of importance to the operator not only from a human factors viewpoint but also from an operation concept. Attention must be given to types of control networks utilized in the various drive technologies. Techniques utilized for speed control involve simple D.C. voltage controls, S.C.R. power supplies, and servo systems among others. Each system and feedback network must be carefully scrutinized for proper applicability to the particular equipment in which it will be incorporated.

Related to the motors and controls is the operational modes that the various drive systems exhibit. These operational modes usually consist of slew, scan and creep. The slew speed normally provides rapid access to a particular portion of the film, while scan and creep modes provide surveillance of the imagery as is done during photo interpretation work on a light table, or rear projection viewer. Contact printers and enlargers require similar scan and slew capabilities with added design refinements (example, synchronization of negative and copy materials).

This portion of the study will therefore determine the type of drive systems required for the various operational modes. Some of the factors to be considered will be:

- precision of drive
- synchronization requirements
- rate stability
- bi-directional drive capability
- feedback design
- speed range
- torque capacity

Depending upon the various system interfaces the components comprising the transport drive will be examined for the most effective standardization.

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2.3.1.4 End-of-Film Sensors

Of importance to any transport design are means and methods for sensing end-of-film and film breakage. Automatic shut off techniques are available that will provide these functions. Some of these techniques utilize spring loaded sensor arms touching the film, other designs incorporate tension sensing devices, dancing rollers or optical sensing methods. The designs of these and other methods will be analyzed and properly documented.

2.3.1.5 Safety

Any film transport design must concern itself with film and operator safety. Film safety includes proper design precluding the possibility of film tearing or ripping. Proper attention must be placed on the design of rollers, guides, belts, platens, etc. that are part of the film path.

Of great significance to printers are the static charges produced when film passes over rollers and metallic surfaces. Eventually the charge discharges producing emulsion burns thereby obliterating imagery. Since static charges result from rubbing friction the transport design must reduce rubbing friction to a minimum and contain static arrestors to eliminate any resultant static. Other beneficial aspects of the static arrestors result in the elimination of the static charge attractive forces between the film and rollers.

Operator safety aspects such as proper electrical grounds, warning lights and effective controls will also be examined for proper application.

2.3.1.6 Mechanical Design

The mechanical design of the various transports systems will be examined for:

- structural integrity
- acoustical properties
- reliability and maintainability

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Structural Integrity

Structural integrity of any transport design is of concern to the equipment and operator. Mild vibrations transmitted to a light table during scanning may not seriously affect the operation, however, serious results occur when the film is stationary and being carefully scrutinized. Film transport vibrations transmitted to the structure can seriously effect printer outputs and duplicated materials. A common defect in transport systems is the lack of mechanical rigidity both within the transport and the interfacing hardware. Good design practices dictates that balanced rotating components be selected outside the range of resonance thereby resulting in a dynamically suited drive.

Acoustical Properties

Mechanical noise annoys the operator, others in the area, and makes communication difficult. Although MIL-E-4158B allows noise levels of up to 70 db in the 300-1000 cps range, this value is considered excessive for concentrated image evaluation. Generally most film transport systems produce acoustical noise well below these values however, attention must be directed to this problem.

Reliability and Maintainability

Practically speaking hardware that always works and never breaks down is an optimum condition that requires some compromise. The compromise concerns itself with a degree of reliability and ease of maintenance. The inter-relationship of reliability and maintainability is one of critical balance. A machine of very high reliability that does not provide a critical on-line function may be tolerated with poor maintainability, since the chances of failure are small, and when failure does occur, the time for repair is not critical. Conversely, a machine with good maintainability may be tolerated with lower reliability. An economic balance is often the determining factor in deciding the values assigned for reliability and maintainability. When the function is "time critical", reliability and maintainability must be high with

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consequent high cost. Generally speaking failure of a film transport system during photo interpretation requires that the function can still be accomplished by manual movement of the film over the light table, this then would indicate a non-critical time function. When synchronous film transports are employed, as in multi sensor image interpretation, does the failure of the transport system begin to seriously affect productivity. Here maintainability is significantly more important than in single film spool transports used on light tables. However, serious results would arise from poor reliability in rear projection viewers and printers where the operator does not have proximity to the transport system. It is obvious that reliability and maintainability criteria must be established for the drives requirements of the equipments.

2.3.1.7 Environment

Another aspect for study would be the environment in which the film transport must operate in. Normally the operational environment for image interpretation equipment and printers requires a sheltered, quiet, dust free, humidity and temperature controlled area to maximize operator efficiency. Film transports that are exposed to this environment, such as light table film transports, will require one set of environmental parameters. Film transports that operate in printers or processors may be subject to corrosive liquids, higher temperatures and other stresses thereby imposing stricter operating constraints.

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2.4 PHYSICAL PARAMETERS AND HUMAN FACTORS

The size, weight, and configuration of the transport mechanism are more dependent upon human engineering factors than upon functional factors. It is obvious that small, lightweight mechanisms are more desirable than large heavy ones; however, optimum sizes may be discussed qualitatively. The drive mechanism should be sized so that major elements may be installed by one man with relative ease. This facilitates adding or removing components as needed for the particular mission. The drive configuration becomes apparent when it is considered that a feed end and a takeup end are basic, and the film path between the two straddles the lighted surface either in a light table or a printer.

Self-threading techniques are beneficial in many equipment designs thereby relieving the operator of tedious and awkward tasks such as having to walk around the equipment for engaging the film at the takeup reels. Therefore, an optimum drive configuration to be considered would be one that locates the drive and take up elements at one end of the equipment. Any self threading technique must examine interface problems with other components and excessively long film paths.

The transport system should be configured to satisfy the following criteria:

- compactness having small light elements
- easy loading
- permit multi-spool drive
- provide wide range film speeds
- prevent film damage
- provide accessible and unobtrusive controls and cranks
- provide smooth film speed control

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- simplicity of design and operation
- threading simplicity

2.5 EVALUATION AREAS

Research and breadboarding of the most promising techniques will be performed as required during the study. The research will restrict itself to automatic loading and threading techniques, film drive and control techniques, and dynamic and static film support techniques. Often fruitful results emerge by combining specific features of various designs to arrive at an optimum solution.

The applied research phase of the study will therefore examine these possibilities and arrive at specific solutions to the film transport problems associated with light tables, viewers, printers and enlargers. Areas that merit breadboarding will be discussed with the contractor's technical monitor prior to implementation.

Invariably the integration of particular aspects of the various design techniques will require some design effort in addition to analytical performance. These efforts will limit themselves to sufficient documentation and breadboarding so as to convey the design outline or parameters and demonstrate feasibility of concept.

2.5.1 Automatic Loading and Threading Techniques

Various approaches to loading and threading films in imagery interpretation and printing equipments are utilized. These approaches entail cassette type loading as used on cameras and tape recording equipments through self-threading techniques used on motion picture projectors. Other techniques utilizing special engaging mechanisms, rollers, guides, belts and built in leader systems are used in various roll feed equipments.

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Emphasis will be placed on arriving at and providing solutions to problems existing with equipments that require disassembly or removal of components when loading and threading film. Attention will also be focussed on methods that could be utilized for random placement of frames into the optical gate such as frame sensing devices and film footage counters.

Preliminary concepts of techniques for implementing film loading and film threading are shown in Figures 2-1 through 2-5. Figure 2-1 illustrates a cassette design that the film spool fits into. The spool is "bench" loaded into the cassette. The cassette in turn is dropped into film transport receptacles utilizing locating pins for alignment and positioning, thereby minimizing operator manipulation.

Film threading techniques are illustrated in Figures 2-2 through 2-5. These figures illustrate various solutions to difficult threading problems associated with various equipments. These figures are basically self explanatory illustrating design concepts for aiding threading of film through critical areas.

The above techniques and other advanced designs realized during the study will be thoroughly evaluated.

2.5.2 Film Drive and Control Techniques

Roll material drives range from simple D.C.motors through hydraulic-pneumatic drives to more advanced capstan drives utilizing closed servo loop feedback controls.

Drives that are interdependent may require a common prime mover or extending linkages that engage synchronized drives. The level of automatic engagement versus manual adjustment must be determined and defined as design criteria. Interrelated computer functions associated with on-line systems must be defined for compatibility. Attention will be paid to capacity and capability of each system to perform as required in the intended equipments.

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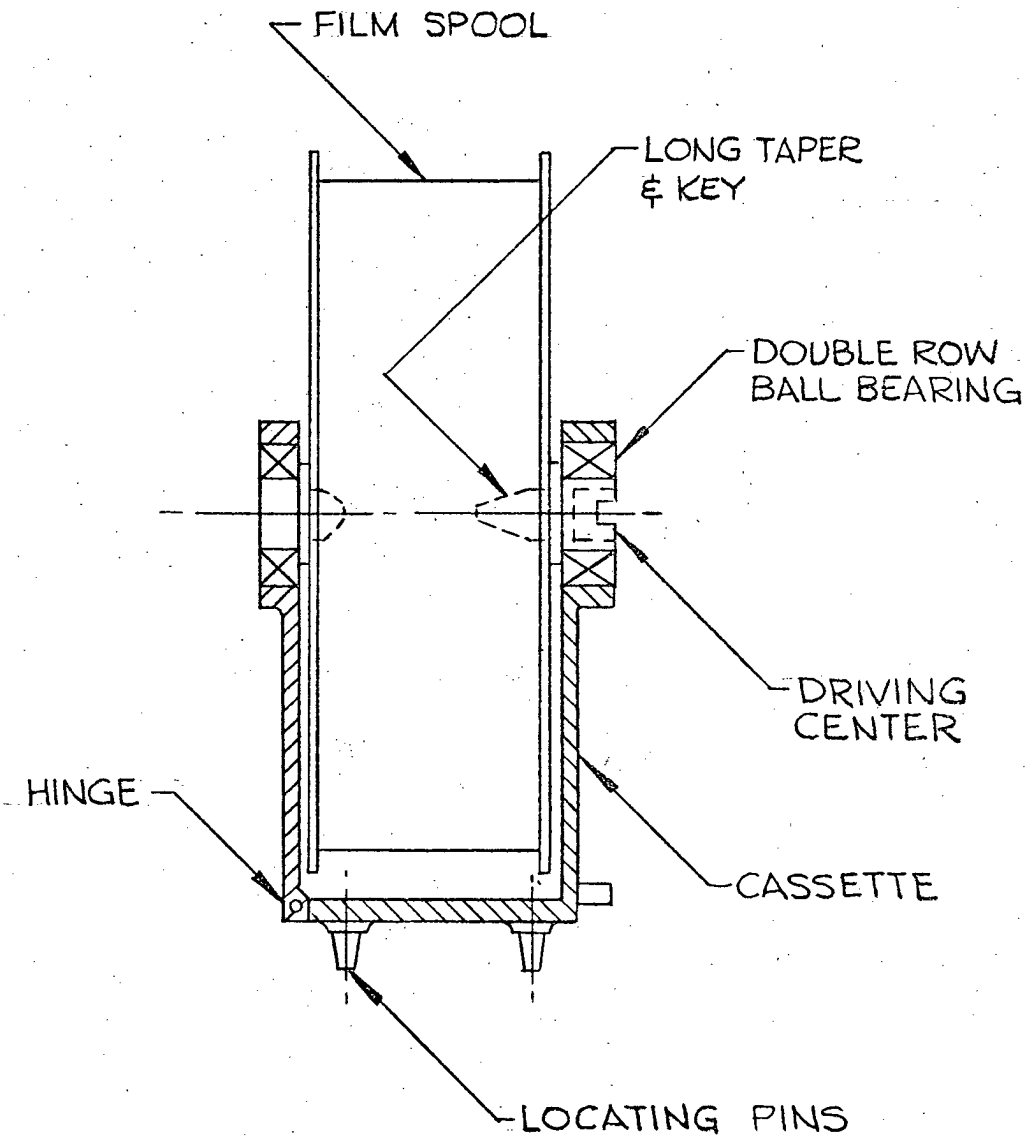

SCHEMATIC REPRESENTATION OF A CASETTE DESIGN FOR FILM LOADING

FIG 2-1

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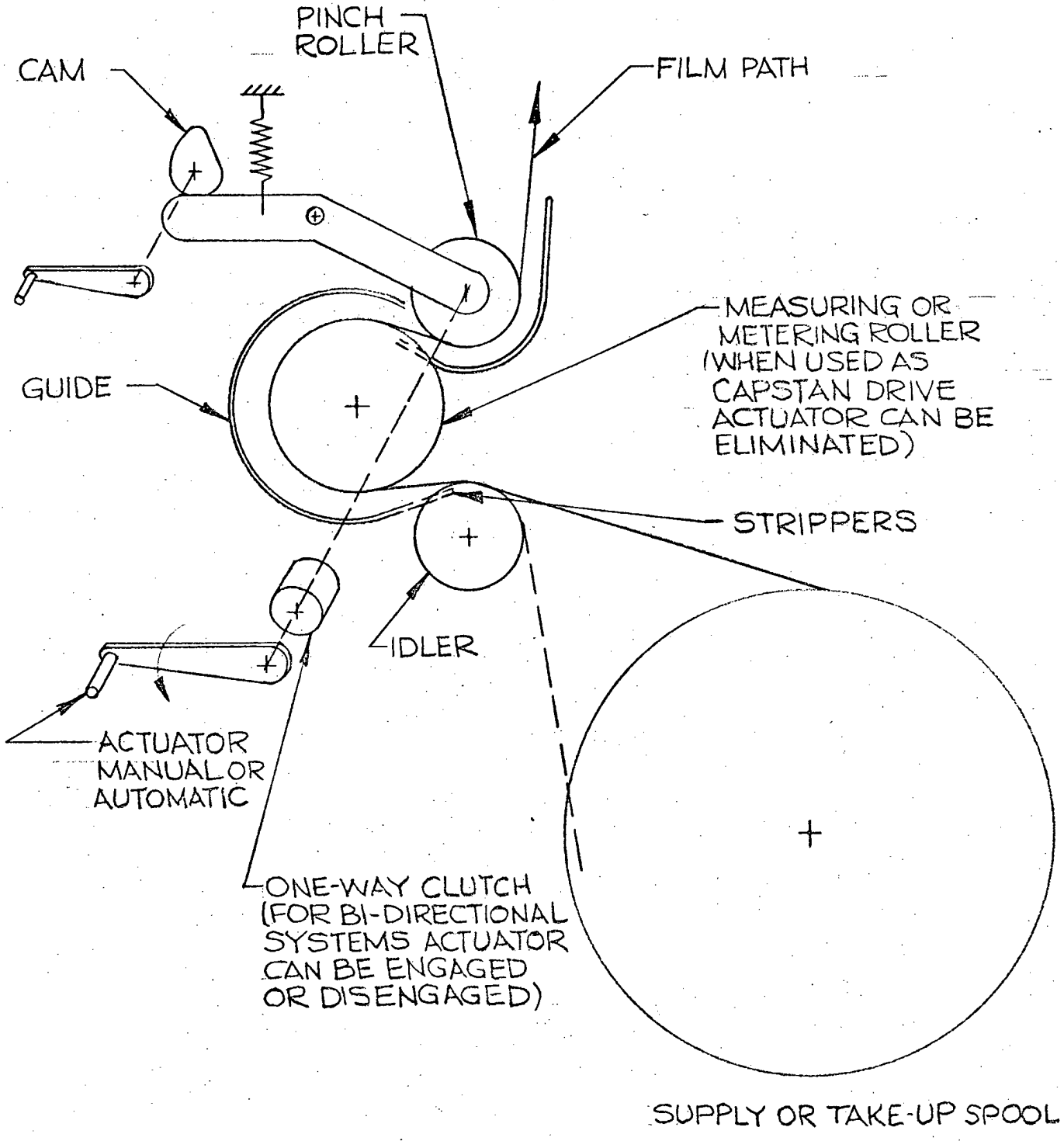
PINCH ROLLER
CAM
FILM PATH
MEASURING OR METERING ROLLER (WHEN USED AS CAPSTAN DRIVE ACTUATOR CAN BE ELIMINATED)
GUIDE
STRIPPERS
IDLER
ACTUATOR MANUAL OR AUTOMATIC
ONE-WAY CLUTCH (FOR BI-DIRECTIONAL SYSTEMS ACTUATOR CAN BE ENGAGED OR DISENGAGED)
SUPPLY OR TAKE-UP SPOOL

THREADING THROUGH MEASURING OR METERING ROLLER

FIG 2-2

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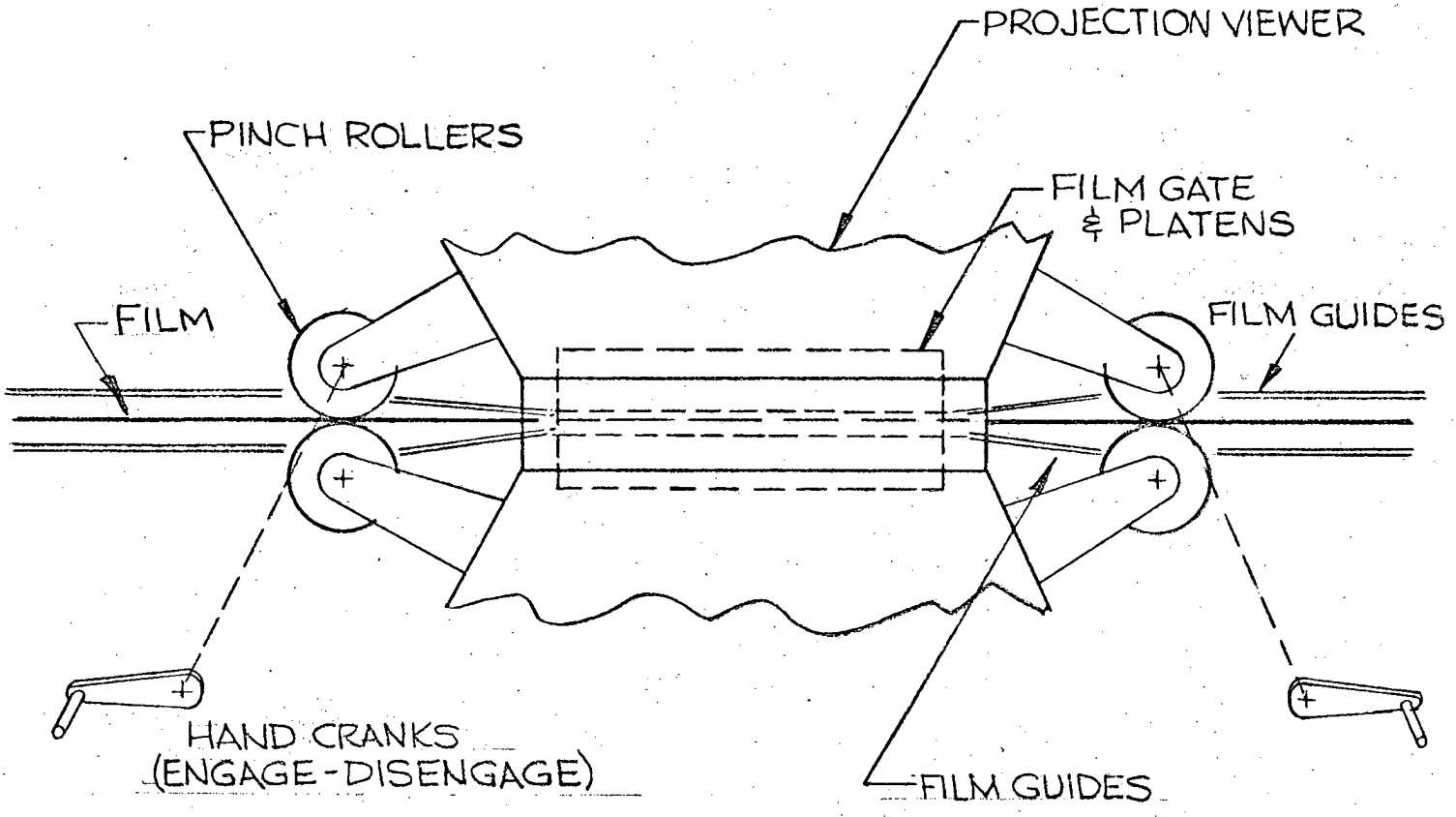

HAND CRANKS CAN BE LINKED TOGETHER AND/OR TIED DIRECTLY TO AN INTEGRATED SELF-THREADING SYSTEM

THREADING THROUGH FILM GATE OF PROJECTION SYSTEM

FIG 2-3

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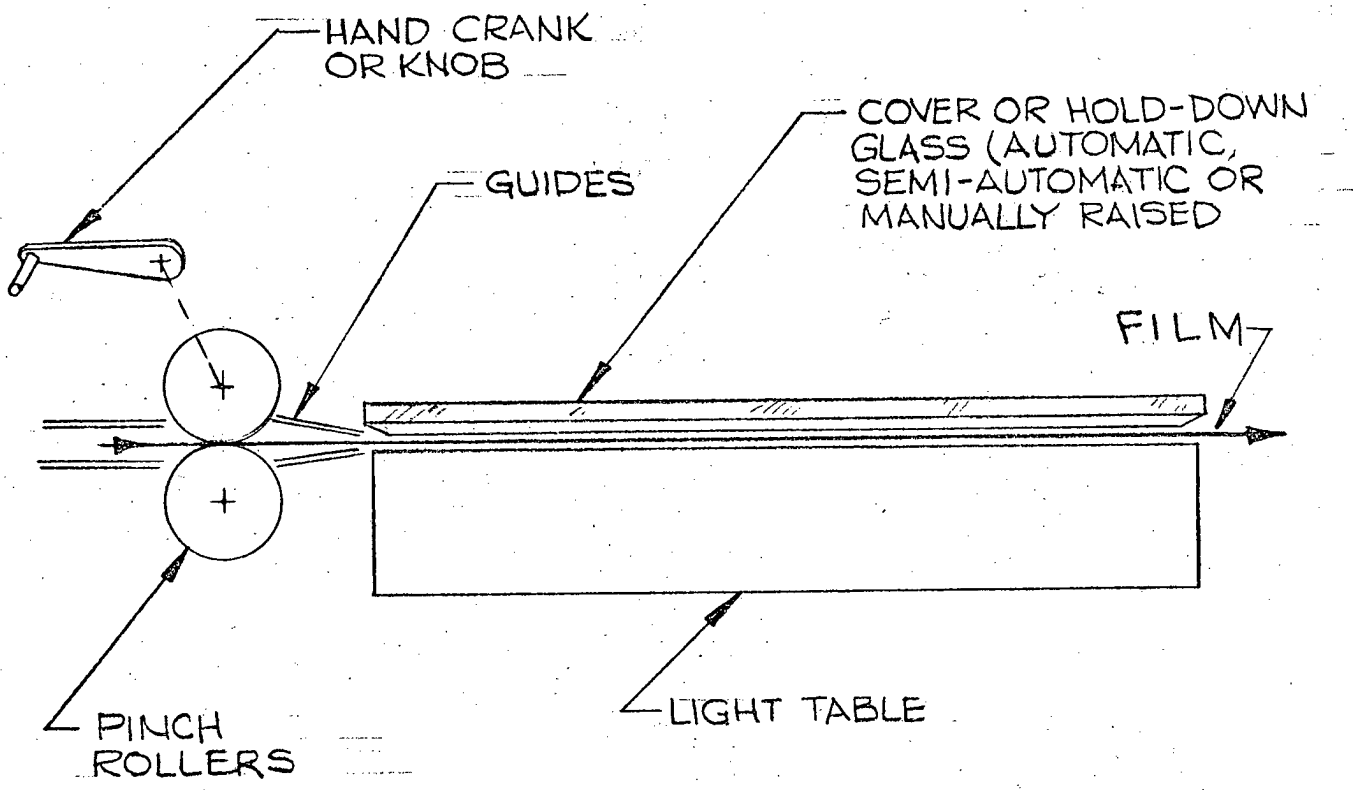

THREADING THROUGH A DIRECT DISPLAY VIEWER

FIG 2-4

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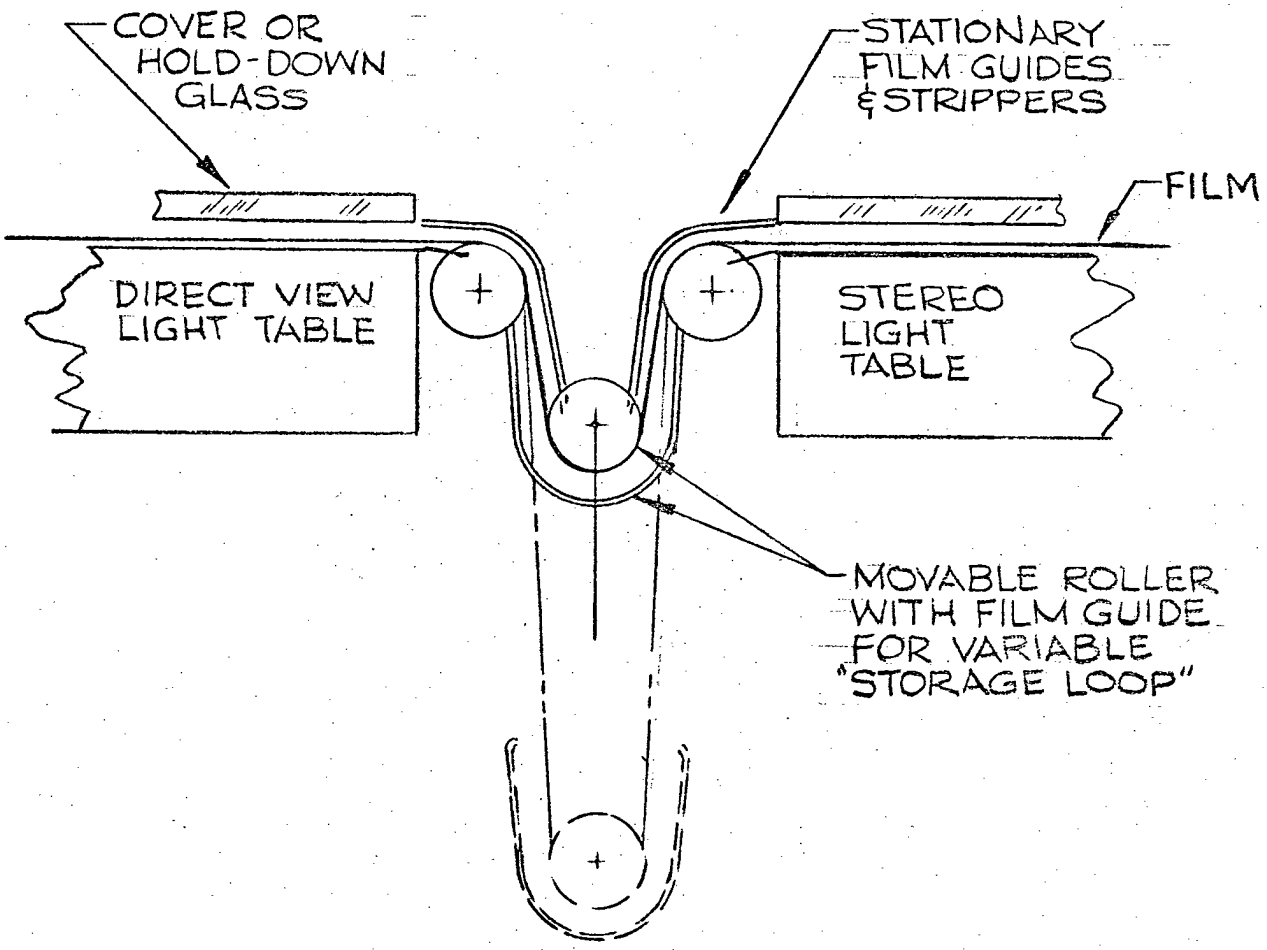
COVER OR HOLD-DOWN GLASS
STATIONARY FILM GUIDES & STRIPPERS
FILM
DIRECT VIEW LIGHT TABLE
STEREO LIGHT TABLE
MOVABLE ROLLER WITH FILM GUIDE FOR VARIABLE "STORAGE LOOP"

THREADING THROUGH A DIRECT VIEW/STEREO LIGHT TABLE WITH "STORAGE LOOP" FOR LONG FORMAT PHOTOGRAPHY

FIG 2-5

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2.5.3 Dynamic and Static Film Support Techniques

Fairchild has performed many in-house investigations towards arriving at solutions for holding film flat at the optical plane. These investigations have encompassed mechanical, electro-static, electro-magnetic and pneumatic means for holding film. This vast scope of experience can greatly aid in determining a technique for holding film flat during transport.

Dynamic Support Techniques

Many techniques have been utilized to maintain film flat at the focal plane during scanning operations. These techniques have included:

- film tension
- edge guides
- liquid gates
- air pressure
- electro-static fields
- roller mechanisms
- sandwich belt transport with vacuum
- belt suspension
- systems based on the Bernoulli effect

The investigation will include the above and other techniques to derive the most desirable method of holding film flat during dynamic scan. It is conceivable that applications of more than one principle must be utilized to afford the required solution. For example, one approach to the problem

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would be to lift the film high above the platen during a scan operation by the utilization of auxiliary mechanisms. This solution may be applicable to rear projection viewers and light tables. Further study would be required to determine all the parameters associated with such a solution, for example maximum allowable film tension, maximum gate size, etc.

Solutions for dynamic scanning could also include tensioning the film perpendicular to its longitudinal axis. Previous FSDS studies have indicated that for 5-inch film a force perpendicular to the film length of 0.25 lbs. per inch is required to stretch the film flat to .0003 inches. This would be sufficiently flat for numerous image interpretation functions. Applications of this technique are shown in figures 2-6 and 2-7. Both cases cause film tensioning due to forces being produced to tension the film during transport. These techniques require support surfaces under the edges of the film. The format areas slide over air thereby eliminating any damage to the film format. Further investigations are required to determine forces required to flatten film up to 9-1/2 inch widths.

Other investigations involved electro-static and electro-magnetic support techniques. These approaches have produced limited results which can be further explored and examined by the proposed study.

Liquid gate techniques have been concerned with reducing and minimizing scratches, digs and abrasions on films from which prints are made. The study will examine the requirements needed for a dynamic and static liquid gate. Investigations of the hydraulic design of the gate would examine pressures involved, methods of fluid application and removal of fluid. Fluid evaporative and contact effects related to film, equipment and operator safety is of considerable importance to liquid gate implementation. Applicability of fluid gates to the various equipments would involve determining interface parameters, film advancing and registration movements, and operating and care taking requirements.

Static Support Techniques

Film support in a static mode have encompassed such techniques as:

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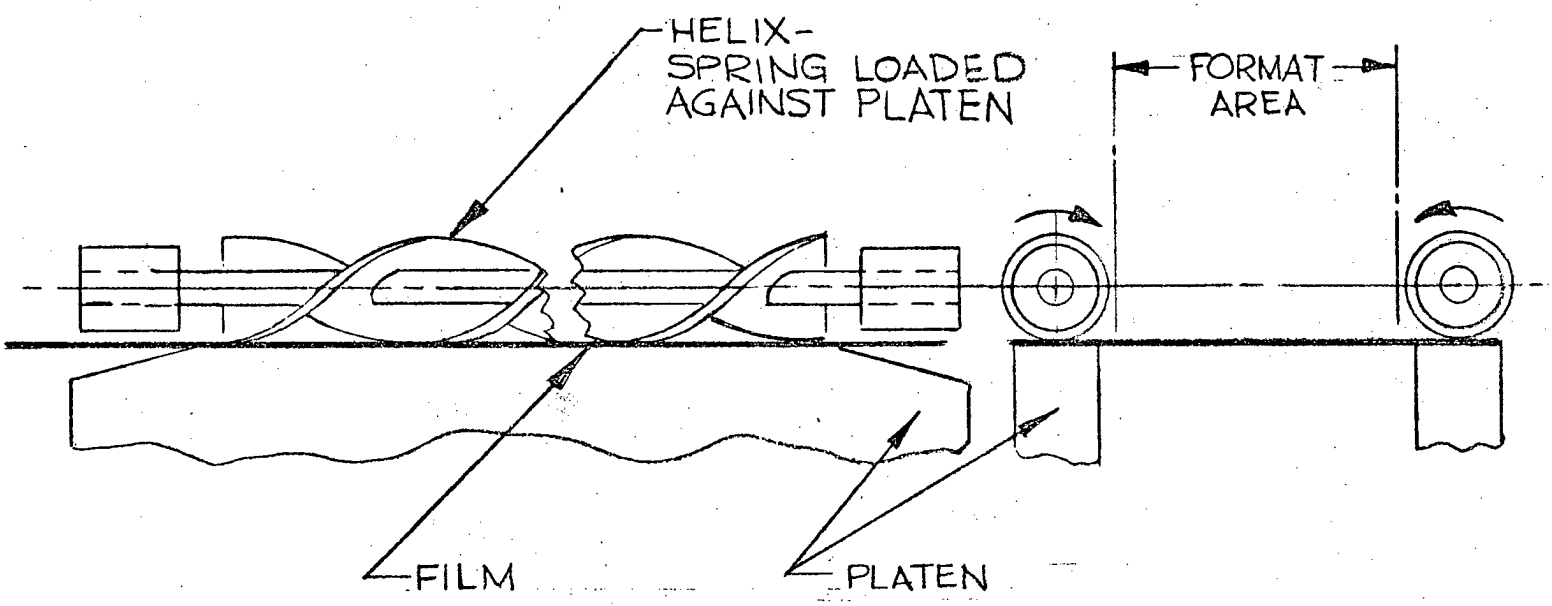

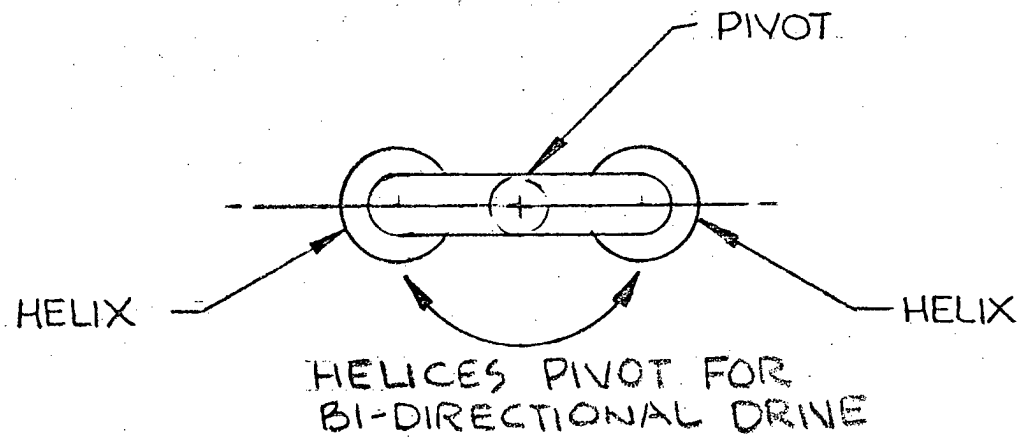

FILM FLATTENING METHOD USING HELIX

FIG. 2-6

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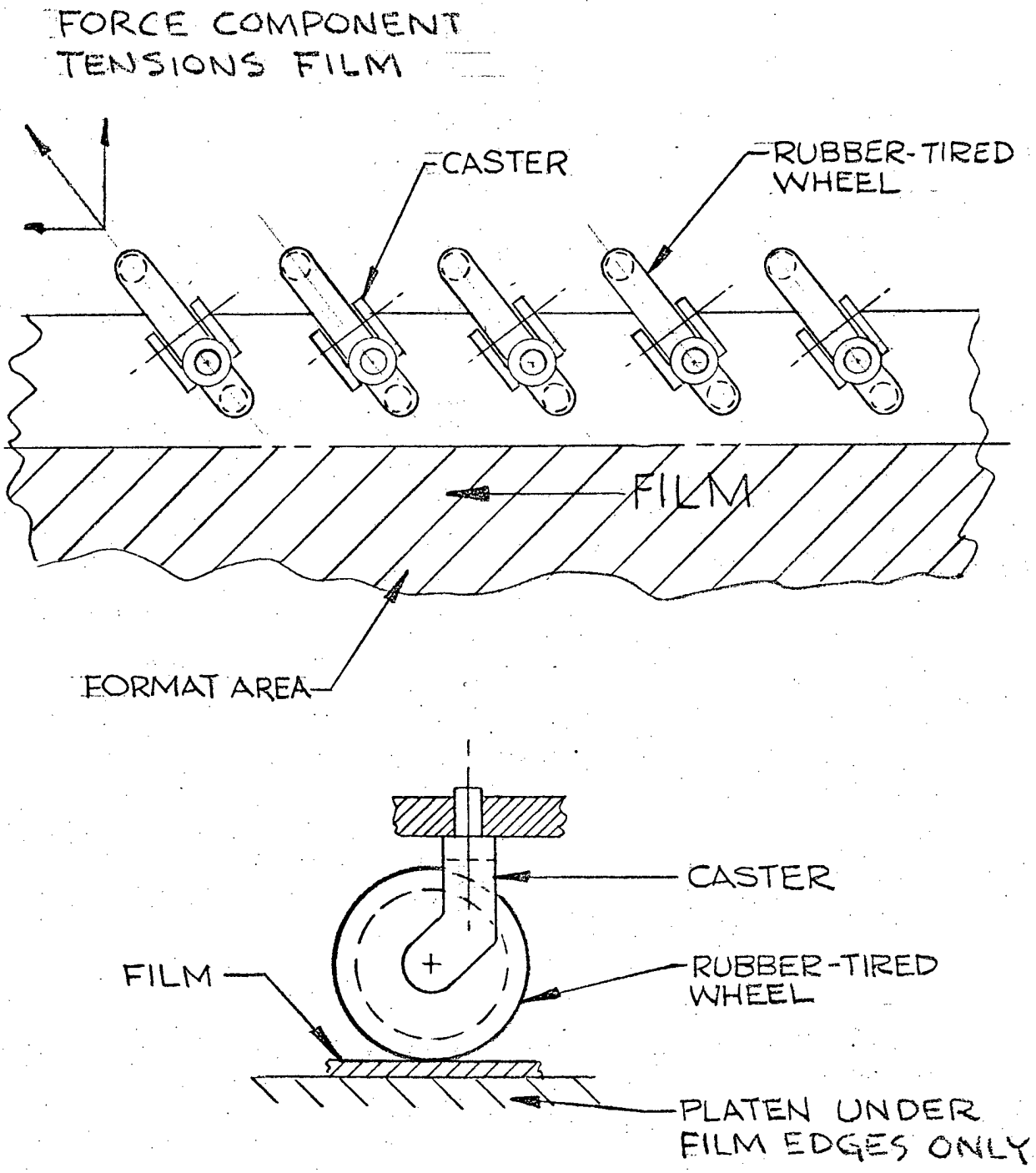

FILM FLATTENING METHOD USING CASTERS

FIG 2-7

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- clamping between platens
- electro-static fields
- electro-magnetic fields
- tension devices
- vacuum
- positive air pressure

The above techniques offer advantages and disadvantages to their implementation in the various equipments. Features such as simplicity of design, operation time lag, complexity of implementation, effects related to film optical degradations, power requirements, and costs are factors which determine suitability of application. Integration of more than one technique will be considered to solve specific problems. For example, an FSDS built contact-printer involved the utilization of clamping glass platens and a liquid gate. Areas of concern with hold-down devices involve recovery release time required for electro-static boards, vacuum platens, and pneumatic hold-downs. Actuation devices for automatic platen control involving fluidic control devices and electro-magnetic methods offer areas for investigation into other methods for static support of films.

2.5.4 Analysis and Recommendations

Complete analysis and recommendations for applicable techniques will be documented. Results of the breadboard designs will be reported in sufficient detail to convey effective representation. All data analysis and recommended techniques will be culminated in the final report. The report will feature in tabular form the results obtained from the comprehensive survey and analysis of film transport systems. The tables will compare the optimum parameter requirements established for each

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of the drives required by the film viewing and printing equipment transport systems. Trade-off studies will outline the recommended transport design parameters. The resulting report will contain sufficient depth and scope coverage so as to enable the Government to use the document as a technology base from which it can draw upon wnen designing new imagery exploitation systems containing roll film transports.

2.5.5 Future Considerations

An important aspect of this type of study program is the orientation of the task to future considerations. FSDS, therefore, intends to include in the study a section highlighting those select fertile areas deemed to merit additional consideration by the Government. The Government may then elect to sponsor additional studies which develop detailed implementation plans to utilize the selected documented technology in advanced imagery interpretation equipments.

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SECTION 3

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SECTION 3

PROGRAM MANAGEMENT

3.1 PROGRAM ORGANIZATION

The program organization delineating the organization flow and personnel assigned to each task of the Automated Film Transport Study is shown in Figure 3-1. The work will be accomplished by the Image Exploitation Section of the Photo Systems Department.

Due consideration has been given to the areas of technical specialities and, therefore, FSDS believes that the organization presented herein affords an excellent task force for the proposed Automated Film Transport Study. This functional organization is patterned as study groups, with each group reporting directly to the program manager for coordination of activities. Resumes of the principal contributors to the proposed study are also included in this section (subsection 3.5).

3.2 PROGRAM CONTROL

The proposed Automated Film Transport Study will be cost controlled by weekly reporting, indicating the hours expended by each of the personnel on the job. This manpower expenditure will be reviewed by the program manager with correlation to the objectives desired within the milestone periods defined.

Emphasis is placed, particularly on study programs, on frequent technical reviews to establish proper direction and determine the state of achievement. It is often difficult to assess progress levels during the course of a study because the earlier periods are devoted to information acquisition and creative analysis. The qualitative results of such efforts are often subjectively reviewed with subsequent poor performance. Fairchild recognizes these faults and by observing good management practice has developed an organized approach to successful study efforts. Three basic precepts are followed to assure commendable performance; namely:

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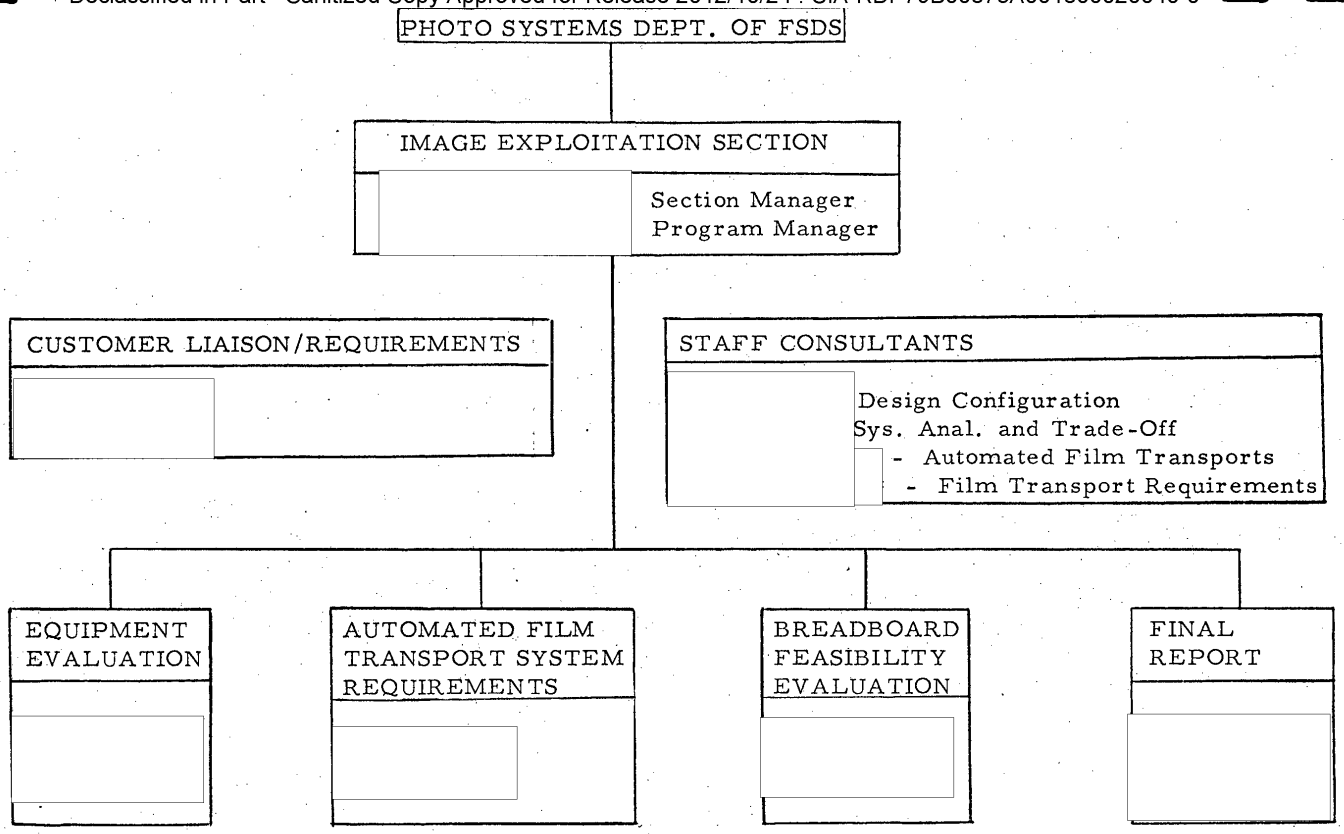

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* Indirect; time not charged to program.

FIGURE 3-1 PROGRAM ORGANIZATION

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a) Clearly, accurately and concisely review the study objectives and all the elements required to achieve these objectives on a time base.

REVIEW WITH CONTRACTING AGENCY AND TECHNICAL MANAGEMENT.

b) Establish periodic scheduled technical reviews with company technical experts who are not directly involved with the studies to obtain objective analysis of direction and progress.

REVIEW WITH TECHNICAL MANAGEMENT.

c) Review study conclusions and recommendations to assure that they are based on the evaluation, analysis and collected data, rather than upon speculative and totally intuitive inputs.

REVIEW WITH CONTRACTING AGENCY AND TECHNICAL MANAGEMENT.

3.3 DELIVERABLE ITEMS

3.3.1 Monthly Reports

Monthly reports will be submitted as of the last working day of each calendar month, and mailed so as to reach the consignee(s) not later than the first business day after the fifteenth of the month following the reporting period. Reports shall follow contractual documentation requirements as outlined in Specification No. DB-1001 and shall include but not necessarily be limited to the following:

3.3.1.1 A statement of the activity on the project during the month and the percentage of work completed as of the reporting date.

3.3.1.2 A statement of the planned activity for the next month.

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3.3.1.3 A statement of pending, unresolved technical problems.

3.3.1.4 A statement of pending, unresolved contractual problems.

3.3.1.5 A statement for the record, of agreements or understandings reached orally during the reporting period on technical matters not requiring the approval of the Contracting Officer.

3.3.1.6 A statement of any proposed change, agreement or understanding which requires the approval of the Contracting Officer.

3.3.1.7 A statement of unanswered, unresolved matters, unanswered correspondence, etc. and whether delinquency is attributed to the contractor or the Government.

3.3.1.8 Status of funds.

3.3.2 Final Report

A final report will be submitted to the Contracting Officer's Technical Representative on or before the thirtieth day following completion of the work under contract. This report will cover the entire design and/or development work accomplished during the period of performance and will contain a section covering the work performed under each of the tasks set forth in the Work Statements. The report will state concisely but completely the major problems encountered, the apparent cause of the problems, the problem solutions and an evaluation of the solutions based on actual application of the solutions.

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3.4 PROGRAM SCHEDULE

The program schedule, shown in Figure 3-2, portrays a simplified time schedule of the significant milestones of the proposed Automated Film Transport Study. A detailed milestone chart will be generated upon award of the contract.

Table 3-1 shows the monthly schedule of the project percentage of completion and related schedule of percentage of project expenditures.

Table 3-2 shows the contributions of the principal personnel assigned to the proposed study in terms of total scheduled hours.

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[redacted] [redacted] Declassified in Part - Sanitized Copy Approved for Release 2012/10/24 : CIA-RDP79B00873A001800020040-0 [redacted] [redacted] [redacted]

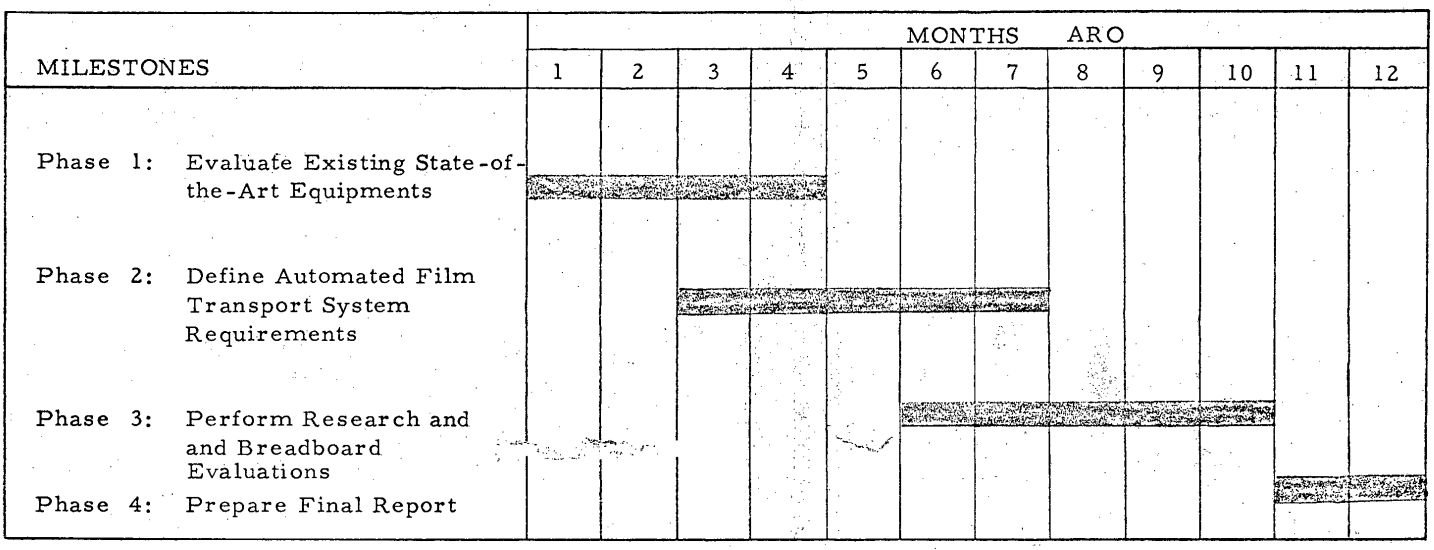

FIGURE 3-2 SIMPLIFIED PROGRAM TIME SCHEDULE

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TABLE 3-1

SCHEDULE OF PROJECT PERCENTAGE OF COMPLETION

Months A.R.O.	Project Percentage of Completion	Percentage Related Project Expenditure
1	6.4	7.1
2	12.8	14.2
3	19.2	21.3
4	27.7	29.4
5	36.2	37.4
6	46.4	48.8
7	58.3	61.0
8	68.5	71.2
9	76.2	78.6
10	82.6	84.2
11	91.1	91.3
12	100.0	100.0

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TABLE 3-2

ENGINEERING PERSONNEL ASSIGNMENTS

Engineer	Total Scheduled Hours
[redacted]	1920*
	1560
	560
	380
	As Required
	As Required
	As Required
	As Required

STAT

* Indirect Labor - Time not charged to program.

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3.5 RESUMES

The following are resumes of the principal contributors to the proposed Automated Film Transport Study.

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SECTION 4

BACKGROUND ACTIVITIES

In the aerospace era where the need for sophisticated data collection is a prime requisite, Fairchild holds a position of technical leadership. Fairchild's leadership, in the specialized technology relating to visual data processing, has evolved over the past 40 years, since the first Fairchild Aerial Camera was introduced. This section presents a summary of the more recent technical accomplishments in terms of the particular Fairchild equipments and staff capabilities that relate to visual data interpretation and processing systems pertinent to the proposed study.

The Image Exploitation Section of the Photo System Department is actively engaged in developing equipments and complete systems in the following technological areas:

Photographic and Video Data Processing Systems

Mapping Systems

Photo Interpretation Systems

Photogrammetric Equipments

Mathematical Analysis and Programming

Detection and Display Systems

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The Image Exploitation Section has innovated new concepts and design approaches to meet the need for automatic equipments which can keep pace with the quantity of information made available by advanced data acquisition systems. Wide experience has been acquired in the automation of photogrammetry, film handling, printing, target location and assessment, and image transfer.

Invaluable experience and insight has been gained in the development of complete visual data processing systems, individual equipments, and corollary software. For example, the Image Exploitation Section has experience in the design of equipment and techniques for tactical reconnaissance missions using multisensor intelligence systems. This work includes computer programming, systems integration, operational and human engineering aspects for quick and/or detailed photointerpretation of infrared, SLR, analog video and visual sensor data.

FCIC has acted as Systems Managers in the development and assembly of complete Ground Reconnaissance Systems, including Data Reduction shelters in production quantities. Examples of these are the Image Interpretation Central and the Ground Data Support System. In addition, a Multisensor Viewer was developed by Fairchild for integrated interpretation and analysis of data for the Image Interpretation Central. Systems have been developed for transmitting aerial photography to ground stations, video displays, video data handling, standardization of photographic format size for storage and retrieval, mobile viewing and interpretation of aerial reconnaissance data, data systems analysis, photogrammetric computation programming efforts, and computer interface and control.

In the development of systems for intelligence and mapping, consideration has been given to storage and retrieval of the data for graphical presentation in decision making functions. To this end, the Image Exploitation Section has developed storage and retrieval systems, mapping

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systems, analytical plotters, planimetric compilers, master point recorders, and cartographic comparators.

The Image Exploitation Section has also been involved in equipment for viewing and reproduction of aerial photography. These equipments include contact printers, projection printers, chip projectors, processors, viewer/printers, film handling devices, copy cameras, and photogrammetric rectifiers. One of the viewers may be utilized for integrated interpretation of multisensor data, and still another projects four separate spectral zonal film images to form a color image.

Examples of some of the specific analysis and programming areas are: Photographic Reduction, Analytical Triangulation for Mapping the Earth and Moon, Orbital Reduction, Advanced Stellar Attitude Determination Techniques, Simulation, Error Theory, Storage and Retrieval, Real Time Programming, Automatic Machine Control Programs, and Developed Advanced Error Correcting Methods and Programs.

The following equipments represent pertinent activities and hardware:

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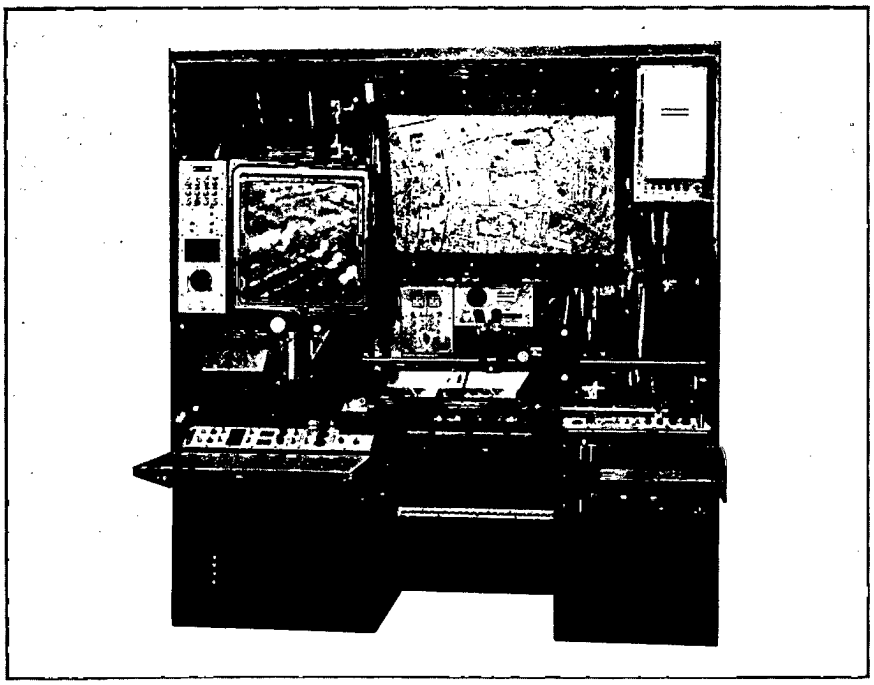
IMAGERY INTERPRETATION SYSTEMS



IMAGERY INTERPRETATION STATION

The Image Interpretation Station provides rapid extraction and dissemination of information contained in imagery acquired by ground and aerial sensors.

Specific features include:

- A dual film transport system with individual channel controls
- A direct viewing display (11 by 22 inches)
- A film projection system with two magnification ranges (3.5X and 7.0X) which projects any portion of the direct display imagery
- A map chip projector (35-chip magazine) which projects 70mm x 100mm reference chips at 9X magnification.
- Both film projection system and map chip projector have 360° image rotation, 10 lines/mm resolution, and 0.1 percent distortion
- Map cursor and film cursor systems with computer and manual links
- Code matrix reader which automatically reads MIL-STD-782B code blocks on roll film for loading into a computer

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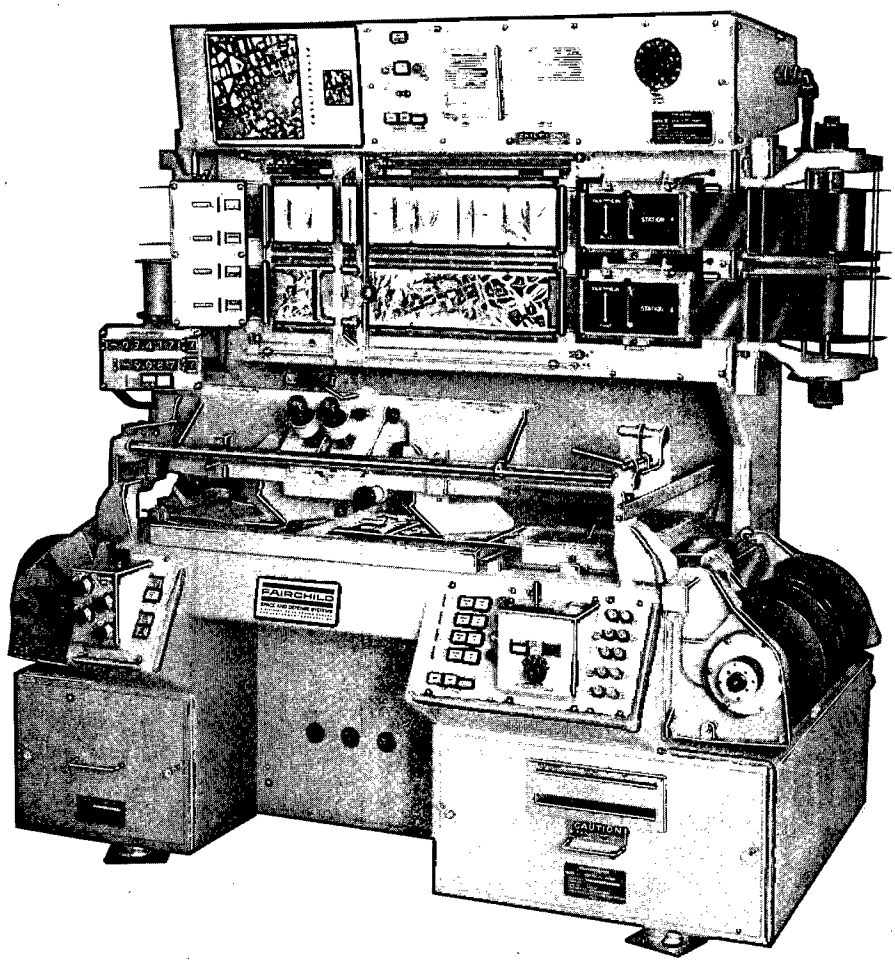
MULTI-SENSOR VIEWER

For Integrated Interpretation and Analysis of Multi-Sensor Data

The Multi-Sensor Viewer was developed by Fairchild Space and Defense Systems, Syosset, New York, for Rome Air Development Center under Contract No. AF30(602)-2882.

The MSV provides simultaneous direct viewing of 70mm to 9-1/2 inch film at four stations. Hard copy print reproduction under normal room light conditions and full mensuration capability, with digital readout, is provided at all four film stations. Stereo viewing with zoom magnification is provided at the two horizontal stations with a slack loop drive on the first station (panoramic channel) for points up to 72" apart. In addition, a projection system located on top, enables viewing of 70 x 100 mm film chips at 4X magnification for comparison viewing. The operator may display at random any one of 64 chips contained in a removable magazine. Three extra chip magazines, each containing 64 chip holders are stored within the MSV.



SPECIFICATIONS:

Dimensions (inches):	74 w x 73 h x 40 d (nominal)
Weight (pounds):	1150 (approximate)
Power Requirements (input):	120/208 VAC, 400 cps, 3 phase, 2200 watts 120 VAC, 60 cps, single phase, 300 watts
Film Capacity:	70mm Rolls up to 1000 ft. (all stations) 5 inch Rolls up to 1000 ft. (all stations) 9 inch Roll up to 1000 ft. (frame station only) 70 x 100mm chips - 64 per magazine (TTR Viewer)
Viewing Surfaces:	9-1/2 x 27 inches (frame station) 5-1/2 x 27 inches (SLR and IR stations) 5-1/2 x 12 inches (two at panoramic station)
Viewing Surface Illumination:	Cold Cathode - Adjustable Brightness 40-1000 ft. lamberts
Vacuum System:	Provided for each viewing surface
Printing:	3 stations with 5 x 9-1/2 inches 1 station with 9-1/2 x 9-1/2 inches
Print Exposure:	1 to 5 seconds
Processing Time:	15 seconds
Film Drive Velocity:	Each station independently adjustable up to 150 FPM, option of individual or ganged drive
Film Footage Counting:	Provided for each station, resettable counters readout to two-tenths of a foot.
Mensuration:	X and Y Digital readout to .001 inch, accurate to .004"/inch. Cross hair positioned by joystick.
Stereo Viewer:	Bausch and Lomb AR26A modified, with zoom magnification range of 2-1/2 to 36 power and image rotation of ±180°
Chip Viewer Magnification:	Fixed - 4 power
Chip Viewer Resolution:	15 lines/mm AWAR at viewing screen

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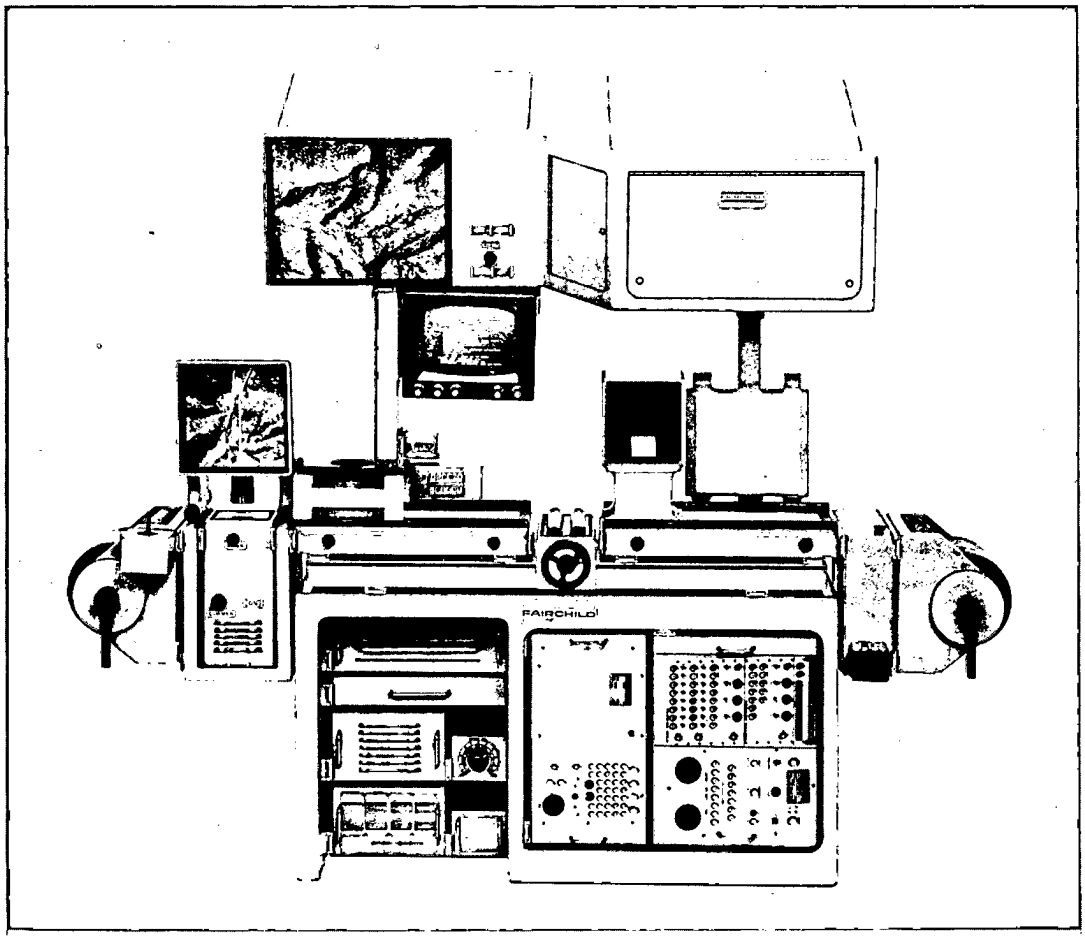
A study of the modular design concept applied to imagery interpretation equipment revealed that, using 43 building blocks, a station could be provided which would meet most of the necessary functions and have considerable flexibility. The complete station using all the blocks and providing combined projection and direct viewing is shown below. Typical configurations assembled from the building blocks are:

- Basic direct viewing for photo screening and cueing
- Rear projection viewing for 70mm and 5-inch film screening and annotation.
- Basic projection viewing for quick copy printing and processing
- Direct viewing for multi-purpose use such as on-line mensuration and display, CRT display, auxiliary display and zoom projection viewers



MODULAR IMAGERY INTERPRETATION STATION

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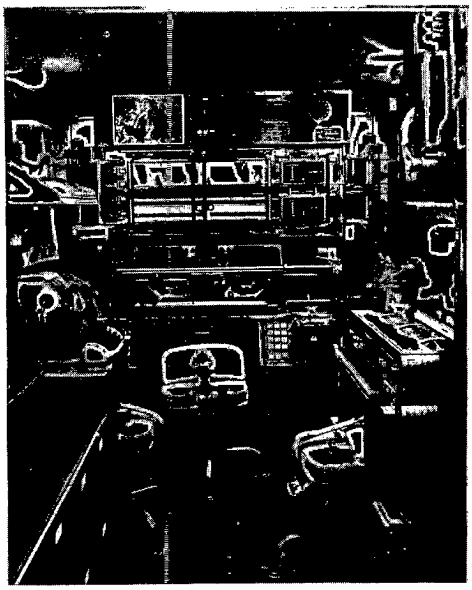
IMAGE INTERPRETATION CENTRAL



The Image Interpretation Central (IIC) was developed by Fairchild Space and Defense Systems Division for Rome Air Development Center. The Image Interpretation Central is designed for mobile viewing and interpretation of aerial photography and allied reconnaissance data. The system displays simultaneously the ground imagery of panoramic, frame, side-looking radar, and infrared photos and compares the results with prior target records.

The system consists of the following equipment:

- Multi-Sensor Viewer Complex - including a control console, four viewers, hard copy printer, processor, TTR viewer, and the stereoviewer.
- Computer Complex - including the computer cabinet, teletype console control station, telephone, and the computer storage cabinet and high speed paper tape sensor.
- Plotter and Map References.
- Auxiliary Light Table and Stereoviewer.
- Storage Cabinets, Work Tables, P.I. Aids.
- Shelter, Air Conditioning, Power Supply and Transporter.

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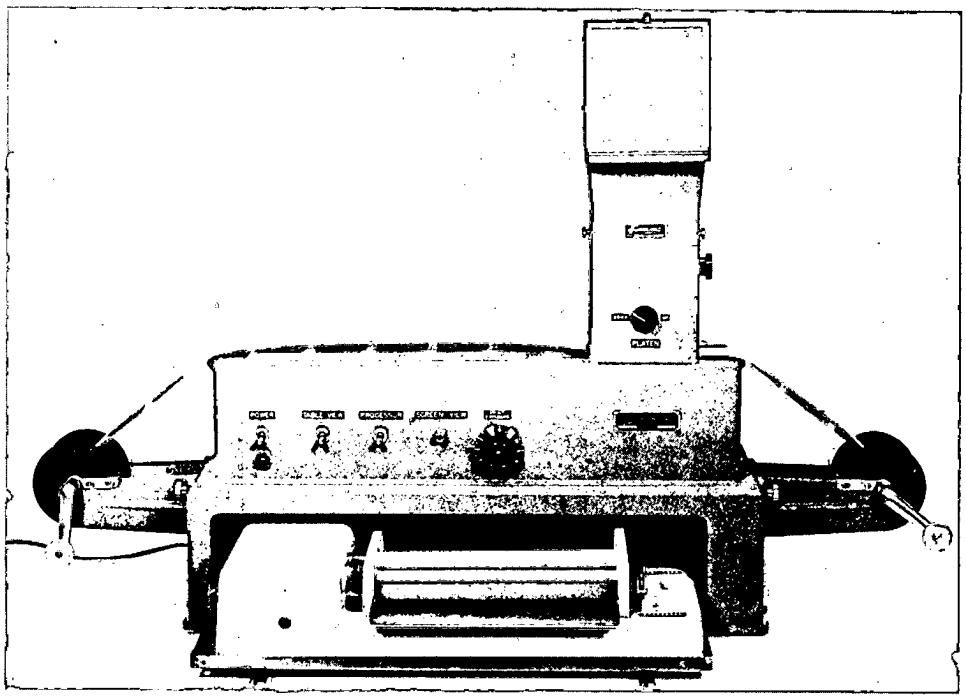
FAIRCHILD MODEL F-511 VIEWER/PRINTER



The Fairchild Model F-511 Viewer/Printer is designed to assist in the rapid interpretation and analysis of frame or panoramic 70/mm aerial film in the field or laboratory. With this versatile unit, the photointerpreter may view the negative film and enlarge specific areas of interest for detailed examination. Hard copy prints of critical areas may be produced for immediate use.

Manual control of roll film up to 1000 feet in length enables the operator to quick-scan photographic mission results as well as perform coding or marking of selected portions directly on the 3-1/2 inch X 12 inch fluorescent light table.

A 2X enlargement of the film can be displayed on a 4-1/2 inch square rear projection screen for further analysis without removal from the roll. Individual photo density and contrast controls permit each operator to adjust the image for best results.

In less than half a minute, the F-511's built-in printer furnishes a positive of the area viewed on the screen without the need for darkroom facilities. The finished prints are comparable to those produced by conventional methods.

The compact Viewer/Printer is easily transportable and is stored in a serviceable carrying case.

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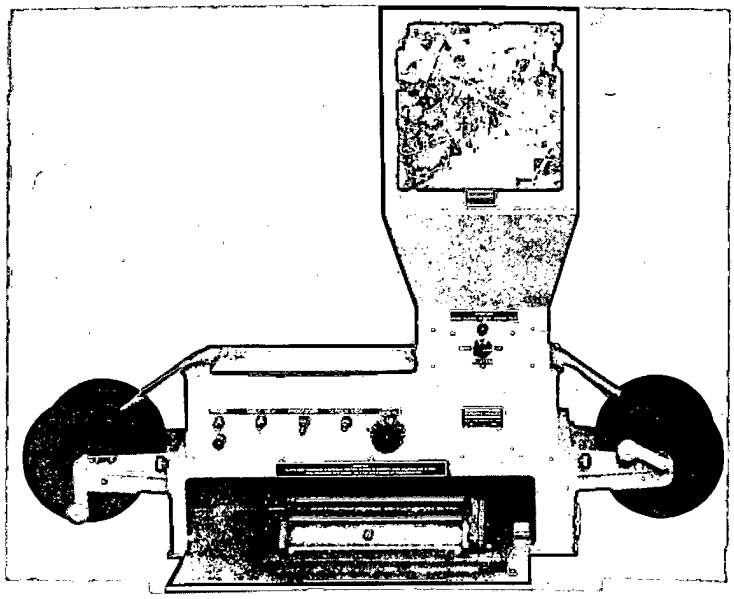
FAIRCHILD MODEL F-512 VIEWER/PRINTER



The Fairchild Model F-512 Viewer/Printer is designed to assist in the rapid interpretation and analysis of frame or panoramic 5-inch aerial film in the field or laboratory. With this versatile unit, the photointerpreter may view the negative film and enlarge specific areas of interest for detailed examination. Hard copy prints of critical areas may be produced for immediate use.

Manual control of roll film up to 1000 feet in length enables the operator to quick-scan photographic mission results, as well as perform coding or marking of selected portions directly on the 5-1/2 inch X 12 inch fluorescent light table.

A 2X enlargement of the film can be displayed on a 9-inch square rear projection screen for further analysis without removal from the roll. Individual photo density and contrast controls permit the operator to adjust the image for best results. Swivelling the display hood rotates the image 90° for convenience in viewing panoramic film.

In less than half a minute, the F-512's built-in printer furnishes a positive of the area viewed on the screen without the need for darkroom facilities. The finished prints are comparable to those produced by conventional methods.

The compact Viewer/Printer is easily transportable and is stored in a serviceable carrying case.

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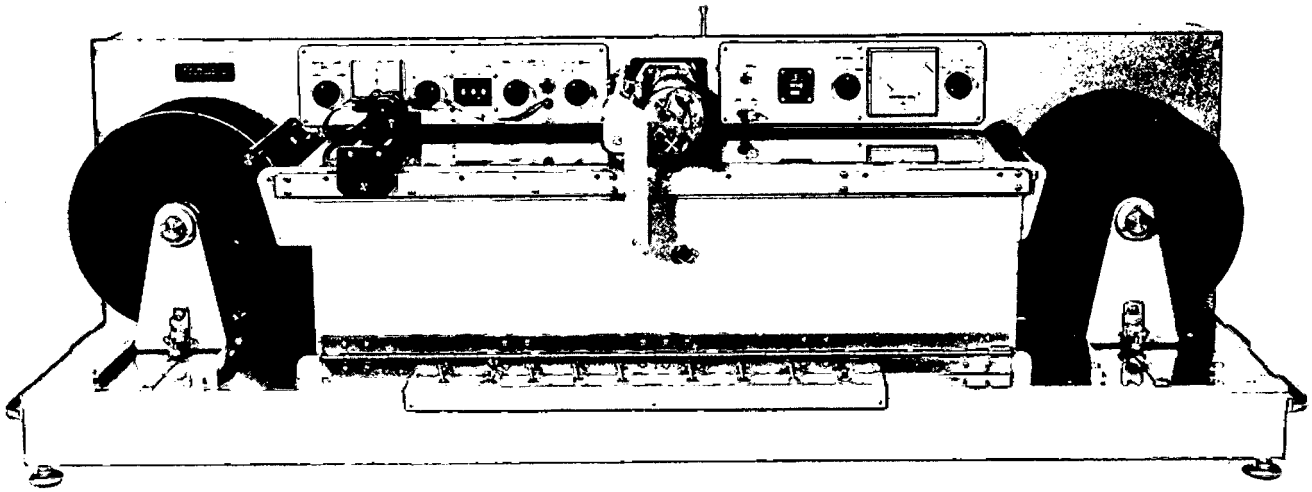

BS-12(XW-1)
Aerial Roll Film Titling Set

FEATURES

- Capability of longitudinal or lateral titling. Frame number advances one count for every frame titled. In addition to standard typewriter font, any hand draftable figure or symbol may be reproduced.
- Film is in continuous motion during titling; titling unit is brought to synchronism with film speed before title is applied.
- Bidirectional film transport and dual viewing tables.
- Frame sensing circuitry allows fully automatic "hands off" titling. Built-in alarm provides an audible indication and stops the titler when three successive interframe spaces are not sensed.
- Permanent and removeable titling ink available.

SPECIFICATIONS

Size – 19" h x 56" w x 19" d

Weight – 250 lbs.

Accuracy of Title Position – longitudinally ±0.160 with respect to trailing frame edge over adjustable range of 5 to 20 inches laterally ±0.120 with respect to the film edge.

Titling Modes – Manual
Interval Automatic
Alarm-off Automatic
Alarm-on Automatic

Film Speed – 0 to 60 feet per minute.

Film Capacity – 10.5-inch diameter spools of 70MM, 5-inch, 6.6-inch and 9.5-inch wide film; thin, thick or standard base; acetate and estar bases.

FAIRCHILD
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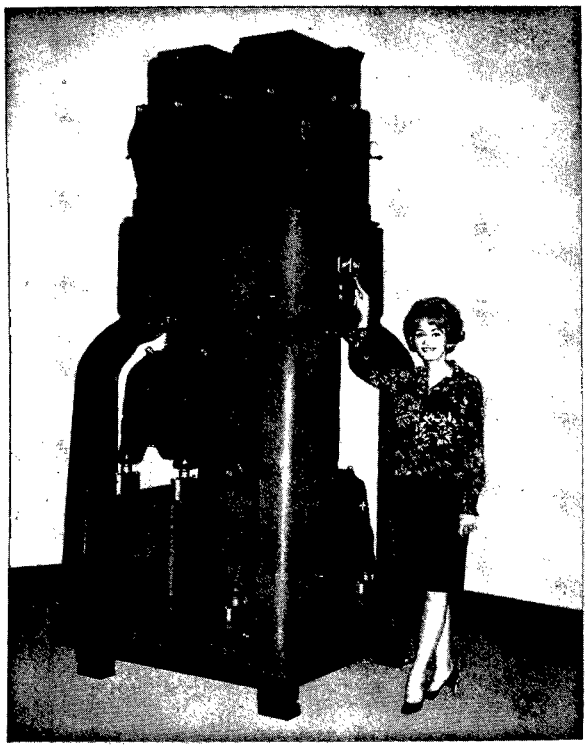
PHOTOGRAMMETRIC PHOTOGRAPHIC ENLARGER



The P/P Enlarger was designed and built under the sponsorship of the Air Force Systems Command, Rome Air Development Center, Griffiss Air Force Base, New York. It extends the state-of-the-art to produce high resolution, very high precision photographic transparencies at 2X and 4X magnification.

The Enlarger incorporates special lenses and illumination, designed to match the spectral sensitivity of specific photosensitive emulsions to achieve unusually good resolution and acutance. The projection lenses are essentially distortion free. Moreover, the input and output planes incorporate precise adjusting mechanisms, which permit easy and accurate alignment of these planes to the optical axis.

Two separate optical paths are incorporated within one housing — one path enlarges 5-inch x 5-inch film 2X; the other, 70 mm by 70 mm film 4X. The output format for each is 9 inches x 9 inches. The short conjugate resolution, when recorded on EK 3404 film, is 200 l/mm anywhere in the format.

Specifications:

Dimensions (feet)	4 X 4 X 9
Weight (pounds)	6,000
Input Format	4.5" X 4.5" for 2X, 70 mm X 70 mm for 4X
Output Format	9" X 9"
Film Capacity Input	5" rolls up to 500 feet, 70 mm rolls up to 500 feet
Film Capacity Output	9" film up to 500 feet
Power	120 VAC, 60 N, 1 ϕ, 1500 watts
Light Source.....	Monochromatic, 4370 angstroms (frequency), bandwidth of 100 angstroms
Lens ..... (FSDS El Segundo)	Angular coverage, 12°; Distortion, 10 to 12 microns; Aperture, approximately f5

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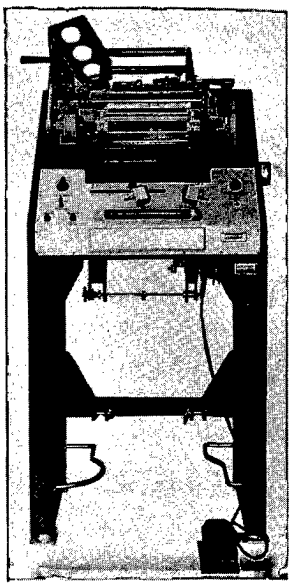
PRE-INSPECTION CONSOLE



Eliminating breaks, tears, or wrinkles from exposed, unprocessed film before it goes into the processor is the mission of the Pre-Inspection Console, Model F-523. The console will accept 70 mm through 9-1/2 inch wide film from up to 22-inch diameter film spools with direct loading film carts, or up to 14-inch spools within the console.

The film moves from the supply spool past defect sensors and a cutter-splicer unit to the takeup spool. When the sensors detect damage, the transport motor automatically stops and an alarm sounds, permitting the operator to insert a reliable splice. Both leader and trailer can be added to the film at this same console.

The console is used to inspect film for tears, nicks, and wrinkles. As the film is conveyed through the console, a mechanical sensor inspects the film with an arm that rides on the edge of the film. When a nick or other defect is encountered, the arm drops into the defect and closes a circuit to stop the film transport. A built-in splicer enables the operator to remove and re-splice the film as soon as damage has been detected.

The Pre-Inspection Console operates under darkroom conditions. This relieves the operator of the manual task of feeling the film as it is transported and results in much faster inspection speeds.

Specifications:

Length	29 inches
Width	30 inches
Height	67 inches
Weight	272 pounds
Power Requirements	115 Volts AC, 60 cps, 650 Watts

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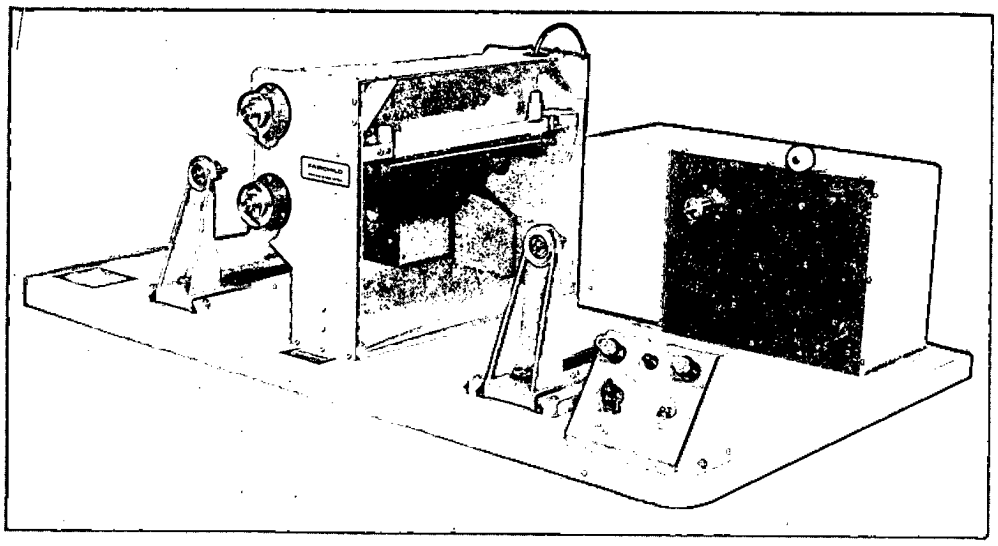
FILM CLEANER



The Film Cleaner, Model F-521, is a compact film cleaning device for efficient removal of dust and lint from 70 mm through 9-1/2 inch wide film. In addition, static charges are also removed, retarding further collection of dust and dirt.

The cleaner accepts 70 mm through 9-1/2 inch film widths, in lengths to 1000 feet. Two tacky rollers clean the film; one contacts the base side, the other contacts the emulsion side.

The speed of the film transport can be set at intervals of 60, 80, or 100 feet per minute to allow optimum setting for particular conditions. A sensing arm rides on the takeup spool to maintain speed within ±15% of set speed. To prevent static buildup on the takeup spool, a static eliminator is mounted at the film exit of the roller enclosure. This high voltage potential static eliminator is capacitance coupled to the voltage source to prevent a shock hazard to operating personnel.

Specifications:

Length	41 inches
Width	24 inches
Height	14 inches
Weight	125 pounds
Power Requirements	115 Volts AC, 60 cps, 500 Watts

FAIRCHILD
SPACE AND DEFENSE SYSTEMS

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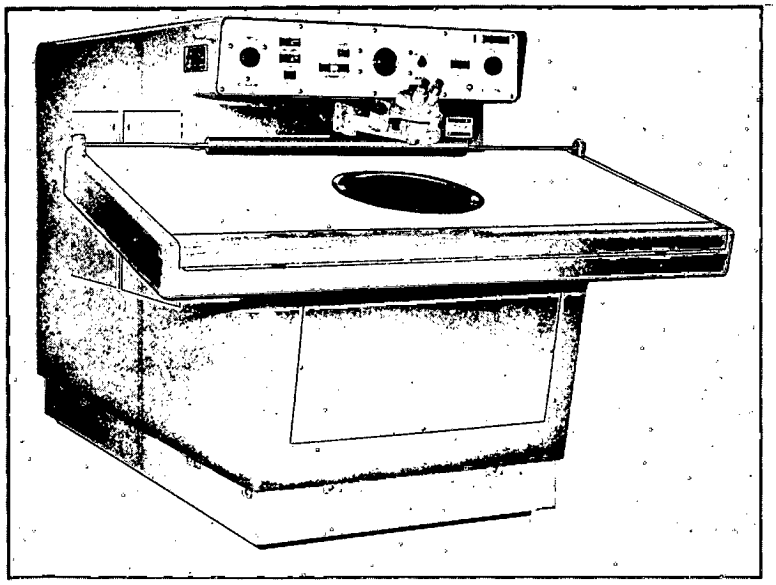
PLANIMETRIC COMPILER

For Chart Revision and Planimetric Compilation



The Planimetric Compiler was designed and developed by Fairchild Space and Defense Systems, A Division of Fairchild Camera and Instrument Corporation, Syosset, New York, under the sponsorship of the Air Force Systems Command, Rome Air Development Center, Griffiss Air Force Base, New York.

The Compiler superimposes high resolution photography on a basic map manuscript through a rear projection screen. After image matching and transfer of the appropriate detail by tracing, the base manuscript may be removed and reproduced for final publication.

The projector has a continuously variable magnification range of 0.5X to 5X and can accommodate roll film or chips from 35/mm to 9.5 inches in width. A precise matching capability is achieved by remotely controlled image translation, 360° image rotation, scale changing and up to 10° of platen tilt.

Specifications:

Dimensions (Inches)		110 X 72 X 60
Weight (Pounds)		Approx. 2000
Power Requirement (Input)		120 ±6 VAC, 60 CPS Single Phase
Lens (Projection)		9.5-inch Artar
Film -	Roll	35 MM to nine inches
	Chip	9 x 9, 4.5 x 4.5, 2-3/4 x 4, 4 x 6

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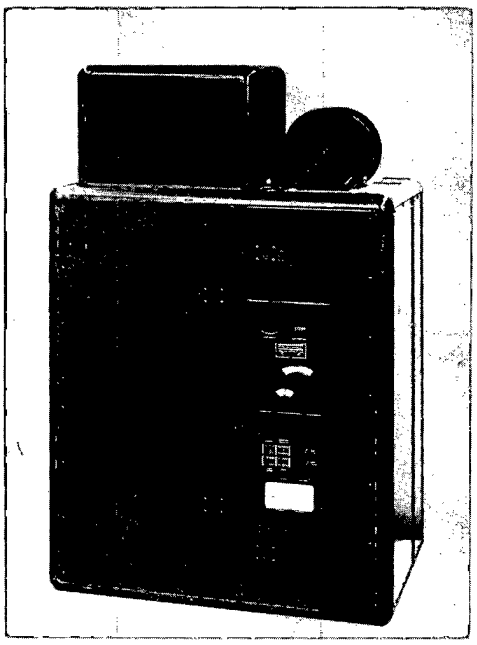
FAIRCHILD MODEL F-405 70/MM/5-INCH IMMERSION PROCESSOR



The Fairchild Model F-405 Immersion Processor is designed for rapid processing of reconnaissance film in field installations where space is at a minimum. This compact processor automatically develops, fixes, rinses and dries 70/mm or 5-inch aerial roll film at rates up to 15 feet per minute.

The novel photo chemistry developed for the unit assures sensitometric consistency and extends storage life by eliminating the oxidation problem inherent in standard processing liquids. In addition, the new inactive developer and activator fix permit film immersion from a minimum of 17 seconds up to 5 minutes per tank, if desired, without adverse effect on film emulsion.

Continuous operation of the processor is made possible by filtration and recirculation of solutions and tank reservoirs for the addition of chemicals and water. The 3-gallon developing, fixing, clearing, and rinsing tanks are equipped with thermostats for optimum results. Designed for easy maintenance, both tanks and inserts are removable within a ceiling height of only 64 inches. A centrifugal blower dries the film in less than 30 seconds prior to automatic rewinding.

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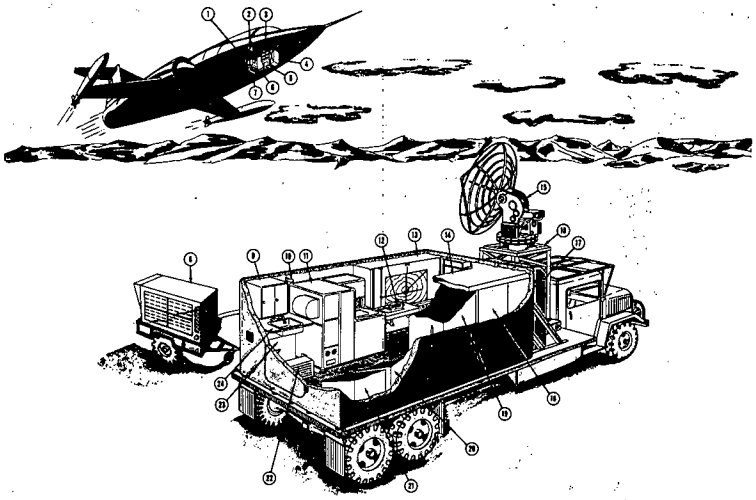
PHOTO TRANSMISSION SYSTEM



KS-64 AIRBORNE SUB SYSTEM

1. JUNCTION BOX
2. MASTER CONTROL BOX
3. PROCESSOR
4. SCANNER
5. CAMERA
6. SLACK BOX
7. TRANSMITTER

AN/TXD-(1) MODIFIED GROUND SENSOR TERMINAL

8. ENGINE DRIVEN GENERATING UNIT
9. STORAGE CABINET
10. AREA LIGHT (TYPICAL)
11. REPRODUCER PROCESSOR
12. STEREO VIEWER
13. PLOTTING BOARD
14. AIR CONDITIONER DUCT
15. RECEIVER ANTENNA
16. RETRACTABLE ANTENNA PEDESTAL
17. AIR CONDITIONING UNIT
18. RECEIVER AND ANTENNA CONTROL RACK
19. REPRODUCER ELECTRONICS RACK
20. DIRECT VIEW MONITOR RACK
21. POWER SUPPLY RACK
22. WATER SUPPLY PUMP
23. WATER SUPPLY TANK
24. UTILITY SINK

The Photo Transmission System developed by Fairchild Space and Defense Systems Division, was the first fully automatic day or night surveillance system capable of taking, processing, and transmitting 70/mm photos from a manned or unmanned airborne vehicle. The first photograph may be viewed at the ground station two minutes after the camera shutter has closed, and each succeeding photo may be viewed every 8 seconds. The ability to obtain photographic intelligence in a minimal time, between the taking of the picture and the viewing on the ground, is a major advantage of the system.

The airborne system, weighing 126 pounds, includes a camera body, rapid processor, and opto-mechanical electronic scanner, temporary film storage box, FM transmitter and subantenna junction box and master control box.

The ground system includes a receiver, monitor and antenna control, ground to Camera-Processor-Viewer, and a Stereoviewer.

The FM signals from the airborne vehicle are received through a six-foot dish-type antenna slaved to the tracking radar. The signals are then converted to a composite video signal which may then be either monitored or viewed as a reconstructed picture on the Direct View Monitor. The reconstructed image is then imprinted on a negative. The processing stage of the new negative is accomplished by the same method as in the airborne system.

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SECTION 5

FAIRCHILD SPACE AND DEFENSE SYSTEMS FACILITIES

The Syosset Facility comprises 306,273 square feet of floor space in three modern, closely grouped buildings. The following briefly describes only those facilities related to R. & D. work.

ENGINEERING SERVICE FACILITIES

Over 170,000 square feet of space are devoted to development facilities such as design and drafting, engineering laboratories, model shops, mock-up construction areas and prototype assembly areas.

ENGINEERING COMPUTER CENTER

This center operates a batch processing engineering computer service for the three East coast operations (Syosset, Copiague and Paramus). The inhouse facility has two IBM 360/30 systems of 32K and 64K memory with high speed readers and printers and tape and disc units. The Engineering Center operates the large machine on the day shift and has use of both on a priority basis. Especially developed software is used to permit efficient scientific and engineering use of these "business" oriented machines. A telecommunications computer tie-line is used to supplement the in-house computers where IBM 360/65 or IBM 7094 capacity is needed.

PHOTO-SCIENCE LABORATORY

This laboratory is equipped with instrumentation and apparatus for establishing standards of photographic processing and testing throughout the Division. It contains densitometers, sensitometers, special precision control photo processing apparatus, spectrophotometers, high resolution projection exposing apparatus and other equipment and standards required in photo science standard work.

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IMAGE INFORMATION AND ANALYSIS LABORATORY

This laboratory is equipped with a specially designed and built equipment capable of scanning imagery in four colors and digitizing the density levels in 64 gray shades and recording on IBM format magnetic tape. It also takes IBM magnetic tape as input and can convert and print out on four stations. It will handle 8" x 10" transparencies at high speed, digitizing at .0007" increments in both dimensions. It is used for research work in image structure, image evaluation, image enhancement, pattern recognition, image rectification, image analysis, multispectral analysis and a number of types of simulation.

ELECTRO-OPTICAL LABORATORIES

These laboratories are equipped with a complete complement of electronic instrumentation and optical instrumentation and are used in work involving electro-optical image sensing devices and systems. Instrumentation is capable of precise photometric and radiometric measurements.

MATERIALS RESEARCH LABORATORY

The Materials Research Laboratory is equipped and staffed for chemical and metallographic analysis and physical testing.

Although the chemical group is set up chiefly for wet chemistry of metals, a limited amount of organic analysis is possible. Among the materials handled are ferrous and non-ferrous alloys, precious metals, fuels, gas and water, lubricants, paints, plating solutions, soaps, adhesives, rubber, plastic and fungicidal materials.

The physical testing group has equipment for tension, compression, shear and transverse bending, fatigue in tension and bending, Izod, Charpy, or tension impact and hardness.

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The metallurgical arm of the Materials Research Laboratory is equipped for macro and micro examination of metals and petrographic samples.

Polaroid-Land photographs of materials under examination can be furnished. For a more permanent record, glass plates or films can be supplied.

The laboratory maintains a current information file on materials and processes and federal specifications. It is staffed and equipped to handle shop problems, field failures, materials and process evaluations, experimental heat treating and plating, and to advise on materials specifications and useage.

MODEL SHOP

The Factory Model Shop is a completely integrated, self-sufficient manufacturing area under cognizance of the program engineers. Employing modern prototype production equipment, the Model Shop is capable of manufacturing parts to extreme tolerances and of performing precision assembly operations. It is fully equipped with a variety of manual and automatic machinery for turning, milling, grinding and jig-boring.

PRINTED CIRCUIT FACILITY

This facility is operated to permit development engineers to "breadboard" circuits on prototype printed wiring boards which most closely resemble the finished product, maintain design costs at a reasonable level, and generate prototype boards quickly, inexpensively and accurately to the tolerances of the program specifications. The laboratory is capable of meeting these conditions and providing a "turn around time" of one hour from receipt of circuitry negative to delivery of final prototype board.

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PRODUCTION DEPARTMENT

Fairchild's production facilities encompass a complete range of machines and tooling capable of processing precision machined parts from the smallest screw to sizeable castings.

The machine shop includes, besides the conventional machines, tape controlled Milwaukee-Matics, Tape-O-Matic drill presses, Pratt & Whitney profilers, De Vlieg jig-mills, Hydroptic, De Vlieg and Swiss jig-borers, Universal cylindrical grinding machines, Barber-Colman gear bobbers, Gould and Eberhardt precision gear cutting machines, Gauthier gear cutting machines, Fellows gear shapers, Sykes shaping machines, Gleason Hypoid gear generators and Fellows gear shaving machines and a sheet metal fabricating facility including spot welding and Heli-Arc welding machines. The department includes a complete plating and finishing facility, paint shop and heat treating facility.

CLEAN ROOM FACILITY

The 1,100 square feet (28' x 40' x 9' high) class 100 Laminar Air Flow Room is the most efficient clean room available, with newly designed filters that remove all dust as well as micro-organisms. All contamination whether visible or sub-microscopic is eliminated or controlled.

To augment this near perfect system of contaminant control, Fairchild has installed Laminar Flow work benches within the clean room. At these benches, the air, instead of recirculating on a closed cycle is drawn into the filters from the general room, providing an ultra-clean work space with 38 complete changes of air over the bench area each minute.

This facility meets the class 100 level at Federal spec 209 and USAF TO-00-25,203.

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A second area, used for mechanical assembly, is 20' x 16' x 8' high, with Cross Flow control and meets the Class 10,000 level.

QUALITY & RELIABILITY DEPARTMENT

The Quality & Reliability Department controls the quality of all parts and products in R. & D. as well as production. It fully meets the requirements of MIL-Q-9858A.

A precision Tool and Gage Laboratory with temperature and humidity control is maintained, where all tools are periodically checked and recorded in accordance with approved tool and gage procedures.

An Electrical and Electronic Standards Laboratory is maintained for periodic calibration and maintenance of test equipment in accordance with MIL-C-45662A.

OPTICAL TEST LABORATORY

This laboratory is set up to perform all testing in accordance with MIL-STD-150A. Besides the essential optical instruments for Ronchi and interferometric tests including reference optical flats to 1/40 wave and of up to 12" diameter, the laboratory contains a single horizontal collimator of 14' focal length and 12" aperture utilizing a parabolic mirror and a multi-collimator set mounted on a heavy concrete vibration isolated floating platform, oriented in the vertical plane and containing ten parabolic mirror collimators of 8" aperture and 10' focal length arranged to cover a total field angle of 90°. Standard USAF three bar targets of both high and low contrast are used.

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CAMERA CALIBRATION LABORATORY

This laboratory is equipped to perform measurements and calibration on precision photogrammetric cameras in accordance with MIL-STD-150A. It is air-conditioned and temperature controlled to ±1°F. The calibrator is a specially designed and built multiple array of 29 collimators of 25" length and 2" aperture arrange in 2 perpendicular vertical planes intersecting to form a cross of two series of targets on the camera focal plane, covering an included field of 90° x 90°. This, together with a precision two-dimensional Mann Comparator and a special computer program permits calibration of cameras to an order of one second of arc.

SPACE ENVIRONMENT LABORATORY

This laboratory is the only facility known to exist in the world with capability for operating and testing visual and photographic systems and performing precision optical performance tests under the combined environments of ultra-high altitude, high and low temperature and vibration. It comprises the Ultrahigh Vacuum Chamber, the Photo-Optical Terrain Simulator and the Vibration and Shock Equipment.

The Ultrahigh Vacuum Chamber is a 3,000 cubic foot space chamber that can record pressures of 4×10^{-9} Torr (equivalent to an altitude of 380 miles). The performance of components and systems can be evaluated at these extreme altitudes and under temperatures from -100°F to +300°F. It is also designed to accept a 28,000 force pound vibration exciter capable of operation at altitudes up to 300,000 feet.

High performance rotary vacuum pumps and blowers make the initital high speed pulldown to 300,000 feet in less than 7 minutes, closely paralleling the rapid ascent of a space vehicle. Then six 32-inch diffusion pumps and liquid nitrogen cold traps further reduce pressure to the equivalent of 380 miles in about four hours.

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A 40-inch diameter optical window in the chamber floor enables sensor systems undergoing combined environmental tests to view the Photo-Optical Terrain Simulator below. The window, flat to 1/10 the wavelength of sodium light, has a thermal radiation shield and temperature controlled mount to minimize the effects of heat, cold and vacuum and assure optimum optical conditions.

The entire 55-ton chamber is isolated from external vibrations above one cycle per second by a massive mount floated on a spring suspension system.

The Photo-Optical Terrain Simulator includes a fan array of eight parabolic mirror collimators with interchangeable static or dynamic targets. The vertical collimator has a focal length of 27 feet and a diameter of 36 inches. The oblique collimators are 8 feet focal length with aperture of 8 inches. Sensors can be evaluated while they are undergoing combined environmental tests at orbital altitudes. The system is housed in a 13-ton movable structure mounted on a 136-ton vibration isolated base. Optical performance under extreme vibration is checked by mounting the sensor system on the vibration exciter. Apparent terrain motion beneath an airborne or space vehicle is simulated by replacing the collimator's stationary reticles with moving reticles on an endless film belt driven by a variable speed motion.

Capabilities of the Space Environments Laboratory include the application of extreme vibration or shock conditions. A 15-ton vibration exciter was developed to meet the special requirements for a system capable of operating at record altitudes and temperatures. The electrodynamic shaker is the first of its kind to deliver 28,000 force-pounds at altitudes up to 300,000 feet and temperatures ranging from -100°F to +300°F.

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For high altitude-temperature-vibration tests, the shaker is moved into the 3,000-cubic foot space chamber. Mounting posts tied back to the ground by separate steel girders eliminate vibration inputs to the chamber.

Sinusoidal signals with a frequency of 5 to a maximum of 3,000 cycles per second, and random noise signals from 10 to a maximum of 2,000 cycles per second are programmed from an MB Model T389 Spectron Equalizer and Analyzer located in an adjacent sound-proofed booth. In addition, through the use of oscillator substitution any 2KC bandwidth up to 6KC can be covered. Multi-channel accelerometer information can be permanently recorded.

To simulate vehicle launch and hard landings, a 600-pound capacity shock machine delivering up to 200 g's is available in the Laboratory complex. Half sine, sawtooth and trapezoidal pulse shapes can be generated.

ENVIRONMENTAL TEST CENTER

The Environmental Test Center is fully equipped laboratory operated by the Quality Control Department. It is equipped with all the necessary environmental instrumentation for the testing of components, sub-assemblies, and small systems to meet the requirements of specifications MILS-E-5272 and T-5422.

Most space and aircraft environments including vibration, shock, acceleration, altitude, temperature, humidity and salt spray can be simulated in the laboratory.

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RADIO FREQUENCY INTERFERENCE LABORATORY

The Radio Frequency Interference Laboratory has capabilities for testing to military specifications, including MIL-I-26600 (USAF), MIL-I-11748B (Signal Corps), and MIL-I-16910 (SHIPS). For tests to specifications such as MIL-I-11748B (Signal Corps), which requires an "open" test area, a suitable site is available.

Three shielded enclosures are qualified for use under applicable specifications, ranging in size from approximately 10' x 22' x 8' to 12' x 14' x 28'. Two rooms are of the double-wall cellular screen-mesh type, useable over a frequency range of 150 kilocycles to 1,000 megacycles. The larger room is a solid-wall metal construction, offering an attenuation up to 100 db in the frequency range of 15 kilocycles to 10,000 megacycles, and full complies with specification MIL-E-4957 (ASG) for shielded enclosures.

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The El Segundo Facility of Fairchild Space and Defense Systems has been established to provide modern and complete optical systems design, manufacturing and test capabilities to meet the requirements of the advanced photo systems and electro-optical systems developed within the Division. In addition, these capabilities are offered to the aerospace industry to meet specific optical system requirements. It occupies a 47,000 square foot building which was specifically designed to meet the demands of advanced optical systems development. An optical data center occupies 2,500 square feet of the El Segundo building. This provides immediate access to a third generation computer facility for the Fairchild optical design staff.

Optical Design

The optical design section has been established and expanded with direction toward the utilization of automated lens design methodology. The computer facilities at El Segundo are among the most advanced and versatile which exist anywhere in the Western world.

It has been found that lens designs which are capable of substantially extending the "state-of-the-art" can be satisfactorily accomplished only by utilizing high speed, moderate to large scale computer machinery. For the specific needs of Fairchild optical design staff, an IBM Series 360, Model 44 scientific computer has been installed. This computer is used extensively in both the initial and final stages of the optical design synthesis and evaluation. In addition, an in-house IBM 1130 data processing system is maintained for those various and sundry optical computations, one-time engineering inquiries and for routine investigations.

Computer Programs

The automatic lens design programs employed have evolved from the ALEC and ORDEALS programs originally compiled at the University of Rochester. These programs have been revised and expanded into a new program system known as PLEAD (Programmed Lens Evaluation and Design), to treat a much wider spectrum of design problems with greater accuracy in a shorter time. Specific improvements developed by Fairchild include the automatic design of aspheric surfaces of all orders in the ray trace program, and the incorporation of physical optical phenomena (as well as geometrical) in the evaluation of wave-fronts. The latter advance allows the designer to much more closely approach the theoretical "diffraction limit" than was heretofore possible.

In addition to the design programs themselves, programs for the analyses of design performance and prediction of lens performance are also in use.

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Computer Programs (contd.)

These make use of geometric and physical frequency response calculations. By applying these analyses, lens performance is quite accurately predicted in advance of manufacture.

Programs are also in use for determining the optimum lens for a given application. These programs take into account such diverse factors as glass homogeniety, manufacturing tolerances, exposure time, I.M.C. errors, thermal gradients, spectral band-pass, field of view, focal length, aperture ratio, etc., in establishing what the best choice of lens parameters will be for a specific effort. They also set "real world" limits so as to immediately separate what can and what cannot probably be achieved in practice.

Optical Fabrication

The Optical Manufacturing Department has been planned to keep pace with the advanced systems requirement, and has been provided with an environment conducive to meeting the fractional wavelength tolerances required of these advanced systems.

Fairchild's Optical Manufacturing Department has modern precision polishing spindles, curve generators and precision edging and centering equipment. Electronic measuring equipment is used by the opticians to determine centration and center thickness of optical elements to micron and sub-micron tolerances. Equipment is available to fabricate optical elements up to 48 inches in diameter.

Aspheric Laboratory

For the manufacture of precision aspheric surfaces (required for some surfaces of advanced high performance systems), a special laboratory has been set up, with superior precision air-conditioning and contamination control. It is equipped with a number of spindles for the generation, lapping and polishing of special aspheric optical surfaces. Both conic sections and generalized (power series) aspherics can be manufactured in diameters up to 24" and to tolerances of 1/20 wave or better. It is equipped with facilities for checking aspherics by null testing methods and, in addition, by means of three specially designed and fabricated equipments for contour and surface profile measuring.

Mechanical Fabrication Facility

The Mechanical Manufacturing Department has been established to provide the exactness necessary in the fabrication of lens housings so that the

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Mechanical Fabrication Facility (contd.)

complete optical assembly can be aligned to the centration, tilt and air-space tolerances necessary. This department has the capability for the machining of beryllium material, which is used to provide lightweight, high strength housings with similar thermal coefficients of expansion as the optical glass. In addition to the beryllium housings, reflective beryllium mirrors are shaped by the Mechanical Manufacturing Department. The beryllium machining area is isolated and controlled due to its inherent toxic properties.

Optical Assembly

The final assembly of the precision systems developed at the El Segundo facility is accomplished in a clean room environment. A laminar flow system incorporated in the assembly area meets Class 100,000 of Federal Standard 209. In addition, a laminar flow work station in the clean room provides an area which meets Class 100 of Federal Standard 209. During the final assembly process, element by element centration measurements and air space measurements are accomplished through the use of electronic indicators. This in-process technique results in the completed system being assembled to the paper optical design to within micron tolerances where required.

Quality & Reliability

The Quality and Reliability Department has been set up to meet the requirements of MIL-Q-9858A and NASA NPC 200-2 and NPC 200-3.

One laboratory contains a 10-foot focal length collimator with an aperture of 10 inches. Two precision vacuum back camera heads are provided so that simultaneous setup and alternate testing can be accomplished, using this one collimator. This laboratory has its own modern dark room facilities.

A second laboratory contains a 25-foot focal length collimator, having an aperture of 15 inches for the testing of longer focal length optical systems. It also has its own dark room facilities.

A third laboratory, now in the design stage, will house a 50-foot focal length collimator with an aperture of 40 inches.

A metrics laboratory is provided for the precision calibration of cartographic optical systems. Other capabilities include the calibration of relative illumination, transmission, sine wave response and square wave response. All laboratories are environmentally controlled for temperature and relative humidity and have special vibration isolation structures.

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